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DOE/EA-0420

Environmental Assessment

Innovative Clean Coal Technology Program
Advanced Flue Gas Desulfurization
Demonstration Project

Pure Air, a Joint Venture Company
Allentown, Pennsylvania

Northern Indiana Public Service Company
Bailly Generating Station
Porter County, Indiana

April 1990

U.S. Department of Energy
Assistant Secretary for Fossil Energy

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ENVIRONMENTAL ASSESSMENT

INNOVATIVE CLEAN COAL TECHNOLOGY PROGRAM
ADVANCED FLUE GAS DESULFURIZATION
DEMONSTRATION PROJECT

PURE AIR
ALLENTOWN, PENNSYLVANIA

NORTHERN INDIANA PUBLIC SERVICE COMPANY
BAILLY GENERATING STATION
PORTER COUNTY, INDIANA

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U.S. DEPARTMENT OF ENERGY
ASSISTANT SECRETARY FOR FOSSIL ENERGY

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ACRONYMS AND ABBREVIATIONS

AFGD	advanced flue gas desulfurization
Btu	British thermal unit
CCTDP	Clean Coal Technology Demonstration Program
CFR	*Code of Federal Regulations*
d	day
dBA	decibels on the A-weighted scale
DOE	(U.S.) Department of Energy
EA	environmental assessment
EPA	(U.S.) Environmental Protection Agency
ESP	electrostatic precipitator
°F	degrees Fahrenheit
ft	foot
g	gram
g/s	gram per second
gal	gallon
gal/h	gallon per hour
h	hour
ICCT	Innovative Clean Coal Technology
IDEM	Indiana Department of Environmental Management
ISCST	Industrial Source Complex Short-term (model)
L	liter
lb	pound
m	meter
mg/L	milligrams per liter
Mgd	million gallons per day
$mile^2$	square mile
$mile^3$	cubic mile
min	minute
MT	metric ton
MW	megawatt
MWh	megawatt-hour
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NO_x	nitrogen oxides
NPDES	National Pollution Discharge Elimination System
ORNL	Oak Ridge National Laboratory
PEIA	programmatic environmental impact analysis
pH	standard unit of measure for acidity and alkalinity
PMSA	primary metropolitan statistical area
Pub. L.	Public Law
RCRA	Resource Conservation and Recovery Act
s	second
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
TSP	total suspended particulates

USFWS	U.S. Fish and Wildlife Service
V	volt
WES	wastewater evaporation system
μg	microgram
$\mu g/m^3$	microgram per cubic meter

SUMMARY

This environmental assessment (EA) has been prepared by the U.S. Department of Energy (DOE) in compliance with the National Environmental Policy Act (NEPA) to evaluate the environmental effects of a Clean Coal Technology Demonstration Program project that is being partially funded by the federal government. The proposed demonstration project entails the installation and operation of an advanced flue gas desulfurization (AFGD) system at the Northern Indiana Public Service Company's Bailly Generating Station, Porter County, Indiana.

The purpose of the proposed demonstration is to determine the technical and economic feasibility of the proposed AFGD technology on a scale that will allow the utility industry to assess its applicability to other coal-burning power plants. The proposed project is intended to demonstrate the capability of the proposed AFGD technology to reduce Bailly Generating Station sulfur dioxide (SO_2) emissions by 90%, and to produce a salable gypsum by-product.

Because of the changes in atmospheric emissions resulting from an AFGD system, the existing air quality is described in detail, and the impacts analysis correspondingly focuses on air quality. Other areas of potential impact include ecology, land use, water quality, and socioeconomics. Commercial operation of the AFGD system at the Bailly Generating Station was assumed to continue for 17 years following the 3-year demonstration project. Commercial operation would result in impacts similar to those of the demonstration project.

Construction of the AFGD system could produce a short-term (4-month) increase in suspended particulate concentrations; however, 24-h average particulate concentrations are not expected to exceed the applicable National Ambient Air Quality Standards (NAAQS) for particulate matter.

The principal effect of operating the AFGD system would be to reduce the current 5.2 lb of SO_2 per million Btu (of coal heating value) emission rate to between 0.52 and 1.2 lb of SO_2 per million Btu. Annual SO_2 emissions would be reduced from the current 70,000 tons to between 7,000 and 16,000 tons. Because operation of the AFGD system would decrease the plant's net efficiency and require consumption of about 2% more coal to produce the same net amount of electricity, emissions of oxides of nitrogen (NO_x) and particulate matter could increase by as much as 2%. Annual carbon dioxide (CO_2) emissions would show an increase of about 5% because of the combined effect of increased coal consumption and the generation of CO_2 when limestone reacts with the flue gas to remove SO_2. Emissions of trace metals may decrease slightly due to particulate removal by the AFGD system.

The AFGD system would result in changes in local ground-level concentrations of pollutants. Conservative modeling analysis predicts a small increase in annual average NO_x concentrations, about a 50% decrease in annual average ground-level SO_2 concentrations attributable to Bailly Generating Station operations, and no measurable change in annual average suspended particulate concentrations. Maximum local concentrations of NO_x, SO_2, and particulate matter are expected to be below NAAQS for all averaging periods.

Construction, demonstration, and commercial operation phases of this project would have negligible effects on surface water and groundwater. Water consumption by the AFGD system would be minor compared with existing operation and negligible compared with the water consumption in the Chicago area. Wastewater discharges from Bailly Generating Station would increase by about 1%. Chloride concentrations in the wastewater would increase from about 10 mg/L to less than 30 mg/L which is the proposed limit for the combined Bailly Generating Station/AFGD system wastewater discharge. Other components of the plant's wastewater are expected to change little. No changes to potential effects on groundwater would be anticipated.

Minor beneficial ecological effects would be expected to result from the proposed demonstration project to the extent that emissions of SO_2 and trace metals are reduced. Consultation with the U.S. Fish and Wildlife Service (USFWS) in compliance with Section 7 of the Endangered Species Act has been completed and indicates that impacts on threatened and endangered species and critical habitat are not expected.

Construction and operation of the proposed project would not affect floodplain uses and values nor would the construction and operation affect wetlands. In fact, the reduction in SO_2 emissions expected from this project should provide a benefit to wetlands by relieving the kinds of stresses on individual wetland species and communities that result from acidic deposition and reduced pH.

Generally, social and economic effects of the proposed action would be minor. The economic activity associated with construction of the AFGD system would be a relatively small addition to the existing high level of economic activity in the area. During the construction period, traffic congestion at the entrance to the Bailly Generating Station would be expected to increase substantially. However, staggered work hours of construction and operating employees would minimize this increase, and traffic on public roads and highways would not be affected.

There may be some short-duration, above-background noise levels in the Indiana Dunes National Lakeshore (a unit of the national park system) resulting from construction. Operation of the AFGD system is expected to result in noise level increases of no more than 1.1 dBA at the national lakeshore. At the national lakeshore's nearest boundary, the current noise level has been found to be between 58 and 61 dBA. The proposed AFGD system is expected to increase the noise level at the national lakeshore's western boundary to between 59.1 and 61.6 dBA. Four hundred feet inside the national lakeshore the noise level is expected to increase no more than 0.1 dBA as a result of AFGD system operation. To minimize any potential for noise impact to this area, a sound-level survey to verify actual operational noise levels will be performed, and mitigation to reduce noise levels will be initiated if they exceed the predicted levels.

Construction would have negligible-land use effects because all construction would occur on Bailly Generating Station. Operation would have very little effect on land use unless the gypsum produced by the AFGD system cannot be sold and must be landfilled. In the worst case, if all the gypsum cannot be sold, then each year approximately 3 acres of additional land would be required to dispose of about 230,000 tons in 20-ft lifts. Adequate off-site landfill capacity is available within 50 miles of Bailly Generating Station.

The Bailly Generating Station currently produces about 40,000 tons of fly ash per year. The characteristics of fly ash generated during operation of the AFGD system would be the same as for the current operation. The quantity of ash generated will increase only as the amount of coal consumed increases. However, during testing of the wastewater evaporation system (WES), up to 1200 lb/h of additional solids would be added to the fly ash over an expected 3 to 6 month period within the demonstration phase of the project.

The proposed construction of the AFGD system will not affect any known historical, architectural, or archaeological sites listed or eligible for inclusion in the National Register of Historic Places. This has been confirmed by consultation with the State Historic Preservation Office under Section 106 of the National Historic Preservation Act. However, if any archaeological artifacts were discovered during construction, work would be stopped and the discovery would be reported to the Division of Historic Preservation and Archaeology in the Indiana Department of Natural Resources.

1. INTRODUCTION

This environmental assessment (EA) has been prepared by the U.S. Department of Energy (DOE) in compliance with the National Environmental Policy Act (NEPA) to evaluate the environmental effects of a Clean Coal Technology Demonstration project that is being partially funded by the federal government and to determine whether or not an environmental impact statement needs to be prepared. The proposed demonstration project involves the installation and operation of an advanced flue gas desulfurization (AFGD) system at the Northern Indiana Public Service Company's Bailly Generating Station.

1.1 BACKGROUND

In December 1987, Congress made funds available for the Innovative Clean Coal Technology (ICCT) program by Pub. L. 100-202, "An Act Making Appropriations for the Department of the Interior and Related Agencies for the Fiscal Year Ending September 30, 1988, and for Other Purposes." This act provided funds for supporting cost-shared clean coal technology projects to demonstrate emerging coal utilization technologies capable of reducing atmospheric emissions of sulfur dioxide (SO_2) and oxides of nitrogen (NO_x), and it authorized DOE to conduct the ICCT program. DOE issued a Program Opportunity Notice on February 22, 1988, to solicit proposals for cost-shared ICCT demonstration projects. The Pure Air proposal for retrofitting an AFGD system to the Bailly Generating Station was one of the 16 technology proposals selected for federal funding from among 55 proposals received by DOE.

1.2 PURPOSE AND NEED

The purpose of the proposed demonstration is to determine the technical and economic feasibility of the proposed AFGD technology on a scale that will allow the utility industry to assess its applicability to other coal-burning power plants. The proposed project is intended to demonstrate the capability of the proposed AFGD technology to reduce SO_2 emissions from the Bailly Generating Station by 90% and to produce gypsum as a salable by-product.

This demonstration project is an important contributor to the achievement of the objectives of the Clean Coal Technology Demonstration Program (CCTDP), of which the ICCT program is a part. CCTDP is a multiphasic effort (Figure 1) consisting of five separate solicitations for clean coal technology projects intended to provide the U.S. energy marketplace with an array of advanced, more efficient, reliable, and environmentally sound coal utilization and control technologies. The ICCT program, which is the name used for the second solicitation, is intended to demonstrate technologies that are potentially more cost effective than existing technologies and are capable of achieving significant reductions in SO_2 and/or NO_x emissions from existing coal-burning facilities—in particular, those that contribute to acid rain and transboundary (United States and Canada) and interstate pollution.

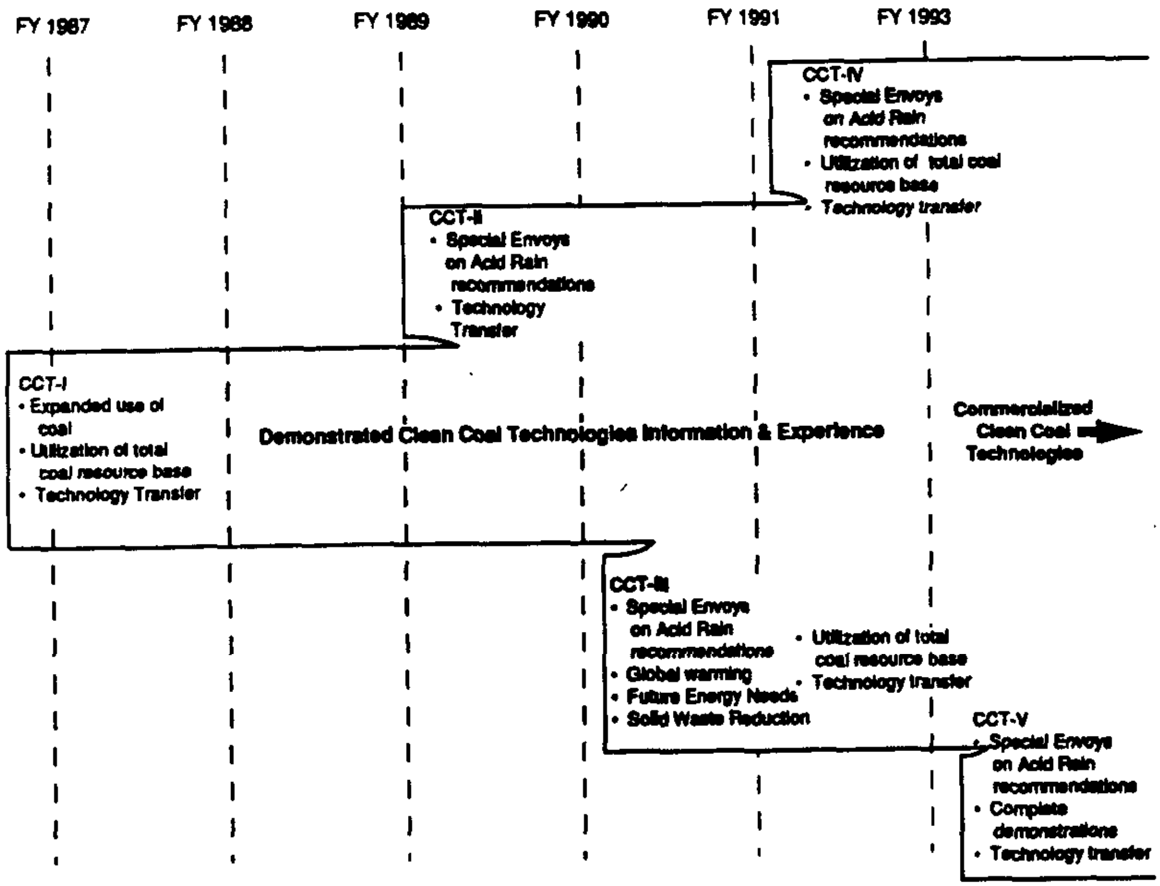

Figure 1. **Clean Coal Technology Demonstration Program strategy.** *Source:* DOE 1989.

1.3 NEPA STRATEGY

An overall strategy for compliance with NEPA was developed for the ICCT program, consistent with the Council on Environmental Quality NEPA regulations (40 CFR Pts. 1500–1508) and the DOE guidelines for compliance with NEPA (52 FR 47662, December 15, 1987). This strategy includes consideration of both programmatic and project-specific environmental impacts during and after the selection process.

The DOE strategy for NEPA compliance has three major elements. The first involved preparation of a comparative programmatic environmental impact analysis (PEIA) based on information provided by the offerers and supplemented by DOE as necessary. The PEIA, issued by DOE as a public document in September 1988 (DOE 1988), compares the environmental consequences of the CCTDP and the technologies it supports with the no action alternative. In the PEIA, results derived from the Regional Emissions Database and Evaluation System, a model developed by DOE at Argonne National Laboratory, were used to estimate the environmental impacts expected to occur by the year 2010 if each technology reaches full commercialization and captures 100% of its applicable market. The environmental impacts are compared with the no-action alternative, under which it is assumed that the use of conventional coal technologies continues through 2010, with new plants using conventional flue gas desulfurization controls as needed to meet New Source Performance Standards. Also, an analysis was made of areas where environmental information is incomplete or unavailable, the trade-offs between short-term uses and long-term productivity, and the irreversible and irretrievable commitment of resources.

The second element of DOE's strategy for NEPA compliance involved preparation of a preselection, project-specific environmental review based on project-specific environmental data and analyses that offerers supplied to DOE as part of each proposal. This analysis contains a discussion of the site-specific environmental, health, safety, and socioeconomic issues associated with the demonstration project. The analysis also includes a discussion of the advantages and disadvantages of the proposed and alternative sites and/or processes reasonably available to the offerer. A discussion of the proposed project's impact on the existing environment and a list of all permits that must be obtained to implement the proposal are included. The document contains options for controlling discharges and for management of solid and liquid wastes and assesses the risk and impacts of implementing the proposed project. Because this preselection, project-specific environmental review contains proprietary and/or confidential business information provided to DOE in the proposal, it is not publicly available.

The third element of DOE's NEPA strategy provides for the preparation and public distribution of site-specific NEPA documents for each of the projects selected for financial assistance under the Program Opportunity Notice. After a consideration of the evaluation criteria, the program policy factors, and the environmental analyses, the proposal submitted by Pure Air was one of the proposals selected for award. This EA describes the action proposed at the Bailly Generation Station project site and analyzes the expected resulting environmental impacts of the proposed action.

1.4 SCOPE OF THE ASSESSMENT

The scope of this EA was determined after consideration of (1) the nature and extent of construction and installation activities at the Bailly Generating Station; (2) the incremental changes in the emissions, effluents, and solid wastes generated by the operation of the AFGD system; and (3) the change in resource requirements for the facility. Commercial operation of the AFGD system at the Bailly Generating Station was assumed to continue for 17 years following the 3-year demonstration project. The AFGD system would operate in essentially the same manner as during the demonstration and commercial operation would result in impacts similar to those of the demonstration project.

Because of the changes in atmospheric emissions resulting from an AFGD system, the existing air quality is described in detail, and the impacts analyses focus on that resource. Other areas of potential impact, including ecology, land use, water quality, and socioeconomics, are also analyzed. The analysis of environmental effects in this EA is based on permit limits or operating conditions that have potential to cause the greatest environmental effects.

1.5 AGENCIES CONSULTED

The following agencies were contacted during preparation of this environmental assessment:

- National Park Service, Indiana Dunes National Lakeshore.
- National Park Service, Air Quality Division, Denver Office.
- Indiana Department of Environmental Management (IDEM), Office of Air Management.
- IDEM, Office of Solid and Hazardous Waste Management.
- Indiana Department of Transportation, Traffic Division.
- Indiana State Labor Department.
- Indiana Department of Natural Resources, Division of Historic Preservation and Archaeology.
- U.S. Geological Survey, Water Resources Division, Indianapolis, Indiana.
- Indiana Division of Nature Preserves, Natural Heritage Program.
- U.S. Fish and Wildlife Service, Bloomington, Indiana, Office.

2. PROPOSED ACTION AND ALTERNATIVES

2.1 THE PROPOSED ACTION

The proposed action is to use DOE's ICCT Program funds to share the cost of construction and a 3-year demonstration of an AFGD system at the Northern Indiana Public Service Company's Bailly Generating Station. The industrial partner in this action would be Pure Air, a joint venture between Air Products and Chemicals, Inc., and Mitsubishi Heavy Industries America, Inc. After the demonstration, Pure Air intends to continue operating the AFGD facility at the Bailly Generating Station under contract with Northern Indiana Public Service Company.

2.1.1 Project Location

The proposed AFGD system would be located at the Bailly Generating Station in Porter County, Indiana. Bailly Generating Station occupies a 300-acre tract of land 12 miles northeast of Gary at the southern end of Lake Michigan (Figure 2).

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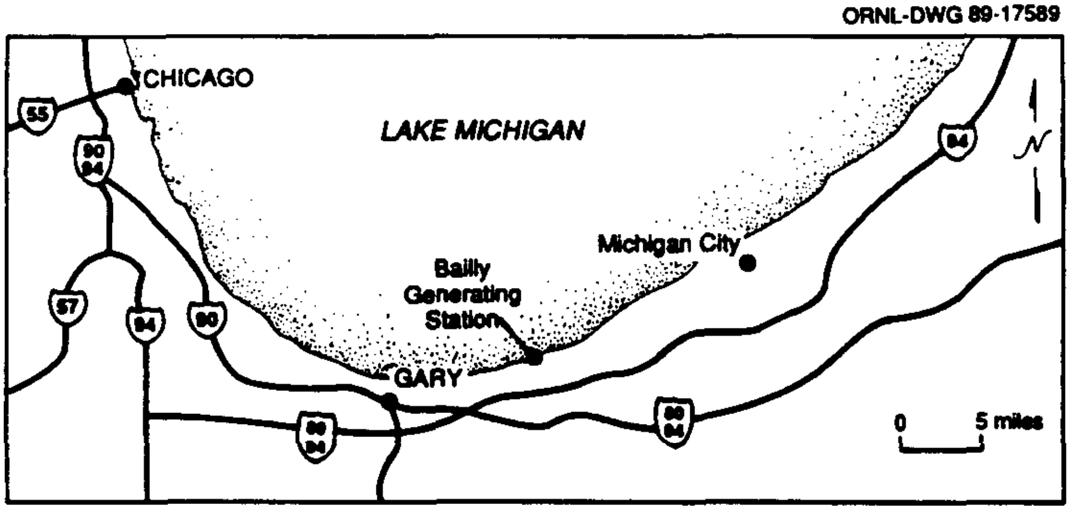

Figure 2. Regional location of Bailly Generating Station.

The site is owned by Northern Indiana Public Service Company, and all activities on the site are related to the generation of electricity. The site is at the edge of an industrial area that has industries such as steel mills, scrap metal processing, glass manufacturing, and stone and clay products manufacturing. Bethlehem Steel Corporation lands bound the site to the south and west. Indiana Dunes National Lakeshore bounds the site to the east (Figure 3).

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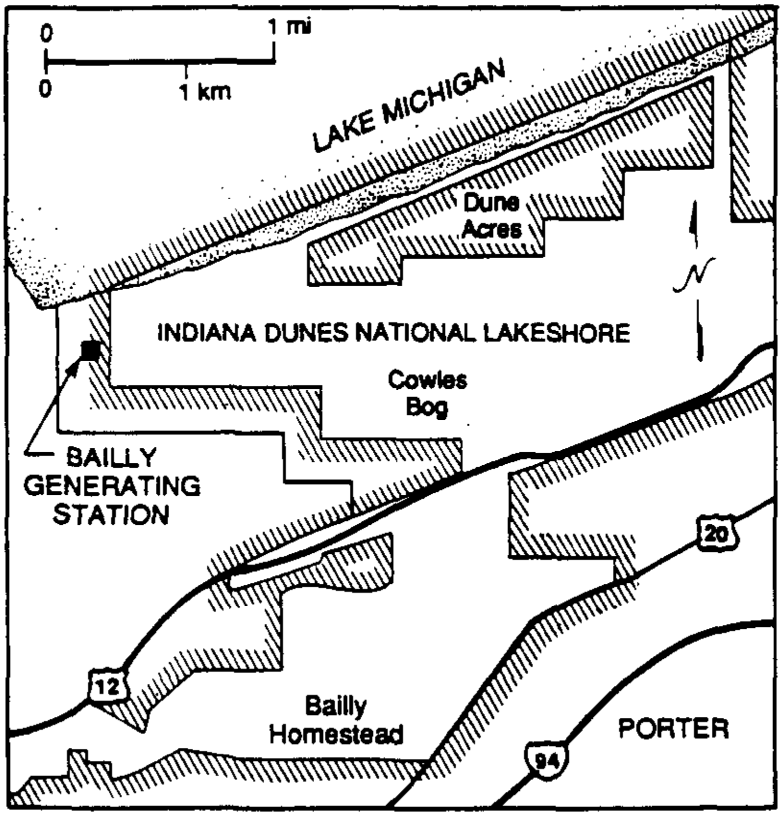

Figure 3. Bailly Generating Station location.

2.1.2 Bailly Generating Station

2.1.2.1 Existing facilities

The main plant consists of two high-pressure steam boilers, each connected to its own steam turbine generator. The station went into commercial operation on December 1, 1962, when the first unit, Unit 7 (rated at 194 MW), went into service. The second unit at the station, Unit 8, entered service in 1968 and is rated at 420 MW. There is also a gas turbine, Unit 10 (rated at 127 MW energy input rate), that is used for meeting peak electrical demand and is permitted to burn natural gas only; this unit will not be affected by the proposed action.

Units 7 and 8 have a combined gross electrical capability of 614 MW, but their operating permits allow operation only at power levels up to 183 and 335 MW, respectively. Most of the plant's electrical generation is distributed to Northern Indiana Public Service Company customers. About 37 MW is used to operate plant auxiliaries.

2.1.2.2 Current operations

The coal burned in the boilers is delivered to the plant in railroad cars. The boilers consume about 1.1 million tons of coal a year to produce about 3,200,000 MWh each year (Pure Air 1989a). Although coal is the normal fuel, natural gas also can be burned in the boilers. Table 1 displays the range of characteristics of the various coals burned at the Bailly Generating Station.

Table 1. Characteristics of coals used at Bailly Generating Station

Characteristic	Average	Minimum	Maximum
Sulfur, %	3.10	2.30	3.87
Moisture, %	10.7	5.0	15.0
Ash, %	10.0	8.0	13.0
Heating Value, Btu/lb	11,500	10,400	13,000

Source: Pure Air 1989a.

2.1.2.3 Existing pollution control systems

Electrostatic precipitators (ESPs) are used to control particulate emissions from the Bailly Generating Station's boilers and to collect fly ash. After passing through the ESPs, flue gases are discharged through a 400-ft stack at about 210 ft/s and temperature of about 300°F.

Wastewater streams at the Bailly Generating Station include once-through cooling water, boiler blowdown, ash sluicing and slag recovery wastewater, metal cleaning wastes, sanitary wastewater and coal pile runoff. The once-through cooling water and boiler blowdown streams do not require treatment before discharge to the outfall to Lake Michigan (a nonchromate water treatment is used). The ash slucing and slag recovery wastewater stream is treated in a series of settling ponds. The metal cleaning wastes and sanitary wastewaters are treated in separate units before discharge to the settling ponds.

The ash pond system at the Bailly Generating Station consists of six ponds: a bottom ash pond, two primary settling ponds, two secondary settling ponds, and a forebay (Figure 4). The ponds are lined and the water in the ponds is recycled to the plant; excess water is discharged with the cooling water. Bottom ash from the station is pumped to the bottom ash pond where the water then flows to one of the two primary settling ponds. Floor drains, demineralizer wastes, and other low-volume wastes also are directed to one of the two primary settling ponds. These ponds then discharge to secondary settling pond No. 1. This pond discharges to a forebay for recycle to the station as ash sluice water or for other uses. Secondary settling pond No. 2 is normally isolated to receive only air heater washes, precipitator washes, or metal cleaning wastes. Sanitary sewer wastes are pumped to a wastewater treatment facility, then discharged to the forebay for recycle. These waste streams are sampled routinely to ensure compliance with National Pollution Elimination Discharge System (NPDES) permit requirements. Deviations from permitted conditions are reported within 5 d to the Indiana Department of Environmental Management.

If a discharge to Lake Michigan is required to control water levels in the pond system, a water quality sample is collected and compared with the NPDES permit requirements. If the sample meets permits limits, a valve is opened to allow a discharge of water to be combined

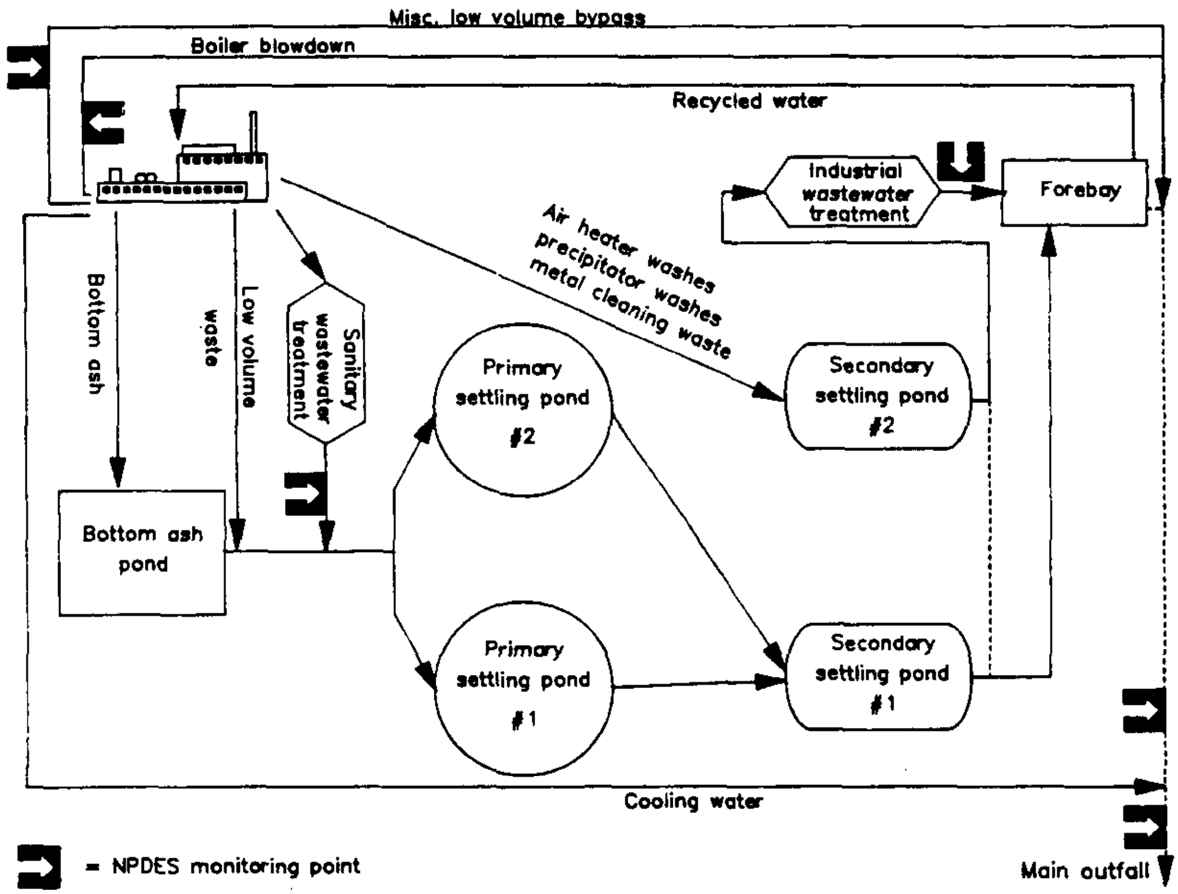

Figure 4. Schematic of the Bailly Generating Station wastewater pond system.

with the cooling water discharge. Discharges from the pond system typically occur one or two times a month for 3 to 4 days at a time. (M. T. Maassel, Manager, Environmental Programs, Northern Indiana Public Service Company letter to Lance McCold, ORNL, Oak Ridge, Tenn., Sept. 15, 1989). No approval is required before discharge but any discharge exceeding permit limits must be reported to the Indiana Department of Environmental Management within five days.

2.1.2.4 Emissions, effluents, and wastes

Each year, the Bailly Generating Station emits to the air approximately 70,000 tons of SO_2, 20,000 tons of NO_x and 1,300 tons of particulates in the course of generating electricity. Bailly Generating Station operates under a permit issued by the Indiana Department of Environmental Management, Office of Air Management. The permit limits Bailly Generating Station air emissions to 6.0 lb of SO_2 and 0.22 lb of particulate matter per million Btu of coal consumed. Northern Indiana Public Service Company reports average emissions of 5.2 lb of SO_2 and 0.10 lb of particulate matter per million Btu. There are no permit limits on NO_x

emissions, but the rate is estimated to be 1.7 lb/million Btu (Pure Air 1989a), based on the U.S. Environmental Protection Agency's AP-42 (EPA 1985).

Wastewater discharges are regulated under an NPDES permit covering the main outfall, intake deicing, and internal discharges. The NPDES permit requires water quality monitoring at a number of points in the wastewater treatment system but there are no permit limits at the main outfall to Lake Michigan. Typically, 221 Mgd, mostly cooling water, is discharged to Lake Michigan. Estimates of current wastewater characteristics at the main outfall are shown in Table 2. Bailly Generating Station does not use any chromium-containing water treatment chemicals, and its permit does not have limits for metals in wastewater discharges.

Fly ash and bottom ash are the two solid waste streams from the station's boilers. These waste streams are exempted from the Resource Conservation and Recovery Act (RCRA) Subtitle C Hazardous Waste Regulations by 40 CFR Pt. 261.4(b)(4). They are exempted also from Indiana solid-waste regulations as long as they are used for approved beneficial purposes (1988 Indiana Pub. L. 103-1988, Sect. 2).

Currently, the Bailly Generating Station ash is sold to a broker for resale for other uses or is disposed of out of state (Pure Air 1989a). Based on current operating conditions, the approximate distribution of ash is as follows (Pure Air 1989a):

Bottom ash to holding ponds	60,000 tons/year
Fly ash to storage silo	39,800 tons/year
Fly ash to stack emissions	200 tons/year

Section 5 describes the expected permits and permit modifications that would be required for the proposed AFGD system.

Table 2. Estimated Bailly Generating Station wastewater discharge characteristics

Parameter	Current discharge[a]
Flow, 10^6 gal/d	221.1
Ca^{++}, mg/L	36.0
Mg^{++}, mg/L	12.3
$SO_4^{=}$, mg/L	23.6
Cl^-, mg/L	10.6
F^-, mg/L	No data
Suspended solids, mg/L	6.2
Total dissolved solids, mg/L	No data
pH	6.5-9.0

Source: Pure Air 1989c.

[a]There are no permit limits at the main outfall to which these values can be compared.

2.1.3 Proposed Flue Gas Desulfurization System

The proposed AFGD system would be built at the northern end of the site (Figure 5). The principal characteristics of the AFGD process are described in the following sections.

2.1.3.1 Process description

The proposed AFGD system consists of five sections (Figure 6): flue-gas ducting, SO_2 removal, limestone feed and handling, gypsum handling, and wastewater treatment facility.

Flue gas-ducting section

The flue-gas ducting section routes hot flue gas from the existing induced-draft fans (Figure 6) to the SO_2 removal section.

SO_2 removal section

The SO_2 removal section routes flue gas through the SO_2 absorber. The scrubbed flue gas leaves the absorber and passes through a mist eliminator before being discharged through the new stack. The mist eliminator removes droplets of water that would otherwise be carried out the stack. The new stack would be 480 ft tall with an exit diameter of 20.2 ft. The stack gas is expected to exit at a average speed of 90 ft/s and at a temperature of 132°F. Northern Indiana Public Service Company's permit application for the AFGD system at Bailly Generating Station calls for a maximum SO_2 emission rate of 1.2 lb/million Btu (Pure Air 1989b).

The SO_2 removal section receives ground limestone from the limestone feed and handling section. The SO_2 forms H^+ and HSO_3^- in the absorber tank. Limestone and air are injected into the absorber tank to convert the HSO_3^- to $CaSO_4$. Gypsum slurry is drawn off to maintain the slurry content of the absorber tank between 20 and 25%. The slurry is stored in a slurry tank before being transferred to the gypsum handling section.

Limestone feed and handling section

Limestone purchased for the AFGD system will have been pulverized so that 95% of it is less than 325 mesh. Limestone will be received in pneumatic truck trailers and pneumatically loaded into limestone storage silos, that have a capacity equivalent to a 3-d consumption at maximum operation. The limestone will be fed from the silos into the SO_2 removal section absorber tank via a pneumatic conveyor.

Gypsum handling section

In the gypsum handling section, slurry from the SO_2 removal section is centrifuged to reduce its water content to between 8 and 10%. The dewatered gypsum cake is transferred by enclosed conveyor to a building where it can be stored until it is loaded into closed trucks for shipment to a wallboard manufacturer or, if not salable, to an off-site landfill for disposal. Part of the filtrate from the centrifuge operation is returned to the SO_2 removal section for use as process water. The remainder of the wastewater from the centrifuge operation is sent to the AFGD wastewater treatment facility.

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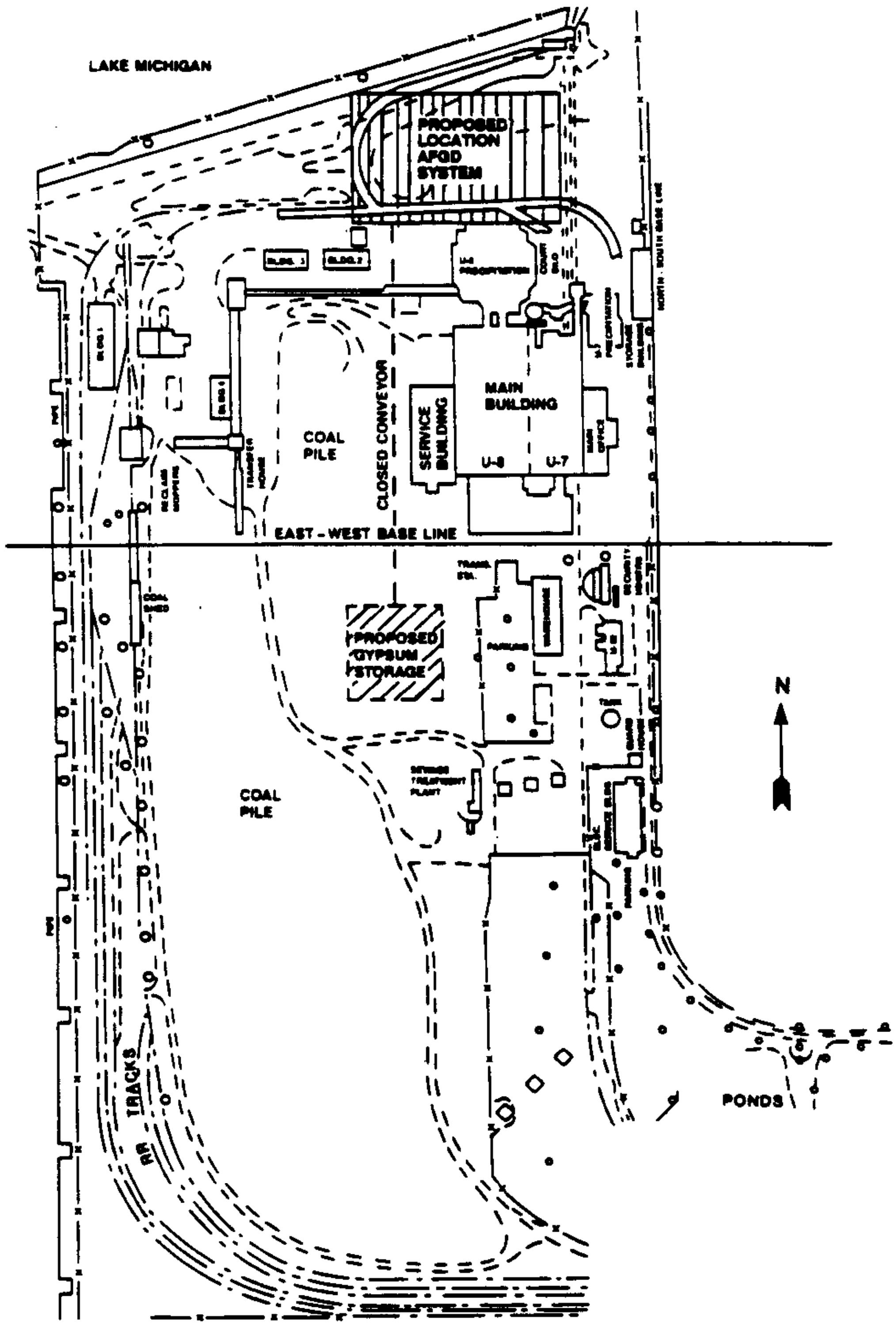

Figure 5. Proposed advanced flue gas desulfurization system location on the Bailly Generating Station site. *Source:* Pure Air 1989a.

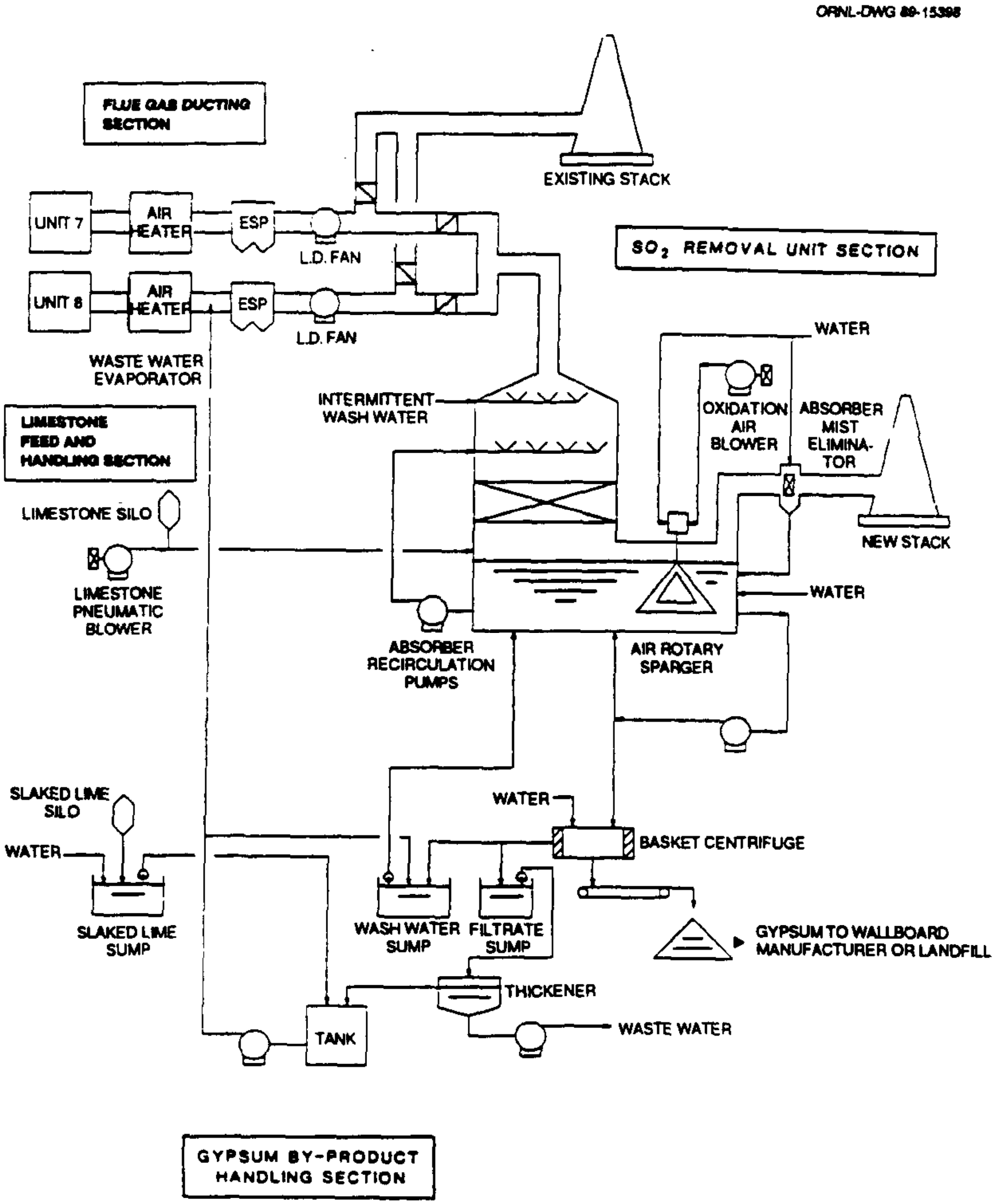

Figure 6. Advanced flue gas desulfurization system flow schematic. *Source:* Pure Air, *Bailly Generating Station Advanced Flue Gas Desulfurization System Final Environmental Information Volume*, Allentown, Pa., 1989.

Wastewater treatment facility

Under normal operations, centrifuge filtrate will be directed to a new on-site wastewater treatment facility. This facility will be designed to remove suspended solids and to adjust the pH if necessary. The treatment facility has not yet been designed, and the degree of solids removal will be determined by the requirements of a wastewater treatment permit that the Indiana Department of Environmental Management would issue for the project. Pure Air has considered vacuum filtration for removal of bulk solids and sand filtration to control residual solids. The treated centrifuge filtrate is expected to be combined with the cooling water and discharged to Lake Michigan.

At some time during the 3-year demonstration phase, a wastewater evaporation system (WES) will be tested. During these tests up to 60% of the centrifuge filtrate will be sent to the WES for disposal. The schedule and duration of this testing has not been established, but it is expected to occur over a 3- to 6-month period.

Wastewater from the gypsum handling section that is sent to the WES is fed first to a pH adjustment tank. Hydrated lime is loaded pneumatically from trucks to a small silo located above the pH adjustment tank, then lime is added to the pH adjustment tank by gravity. The pH adjustment converts chloride and sulfate ions to calcium salts so that they will not evaporate in the flue gas. The wastewater is then pumped through nozzles into the duct carrying the flue gas to the Unit 8 ESP. Water is evaporated in the duct, and solids are captured by the ESP. Because only Unit 8 would be equipped with a WES, only about 60% of the design wastewater flow can be evaporated. However, demonstration at this scale is sufficient to determine the technical and economic feasibility of the WES for future commercial systems.

2.1.3.2 Construction activities

Construction activities include site preparation; assembly of buildings and structures; construction of the 480-ft stack; construction of conveyors, mechanical equipment, silos and tanks; installation of electrical equipment; painting and insulating; and landscaping. Site preparation requires 4 months and includes the construction of a retaining wall and emplacement of about 60,000 yards^3 of fill. Construction will continue for about 27 months. Approximately 6 acres will be used during construction, but the completed AFGD system will occupy only 4 acres. Figure 7 is a plot plan for the proposed AFGD system.

2.1.3.3 Schedule

The project is expected to be completed in 68 months. Following DOE approval, construction activities would begin in April 1990 and would continue for 27 months. After startup and verification of the AFGD equipment operation, the 36-month demonstration phase of the project will begin; the AFGD system will be tested using a range of coals and operating conditions. At the conclusion of testing, Pure Air will submit a final report to DOE.

2.1.3.4 Resource requirements

Operation of the AFGD system requires about 7.6 MW of continuous electrical power. Construction will use electrical power also, but it will require a small fraction of the electrical power used for operation.

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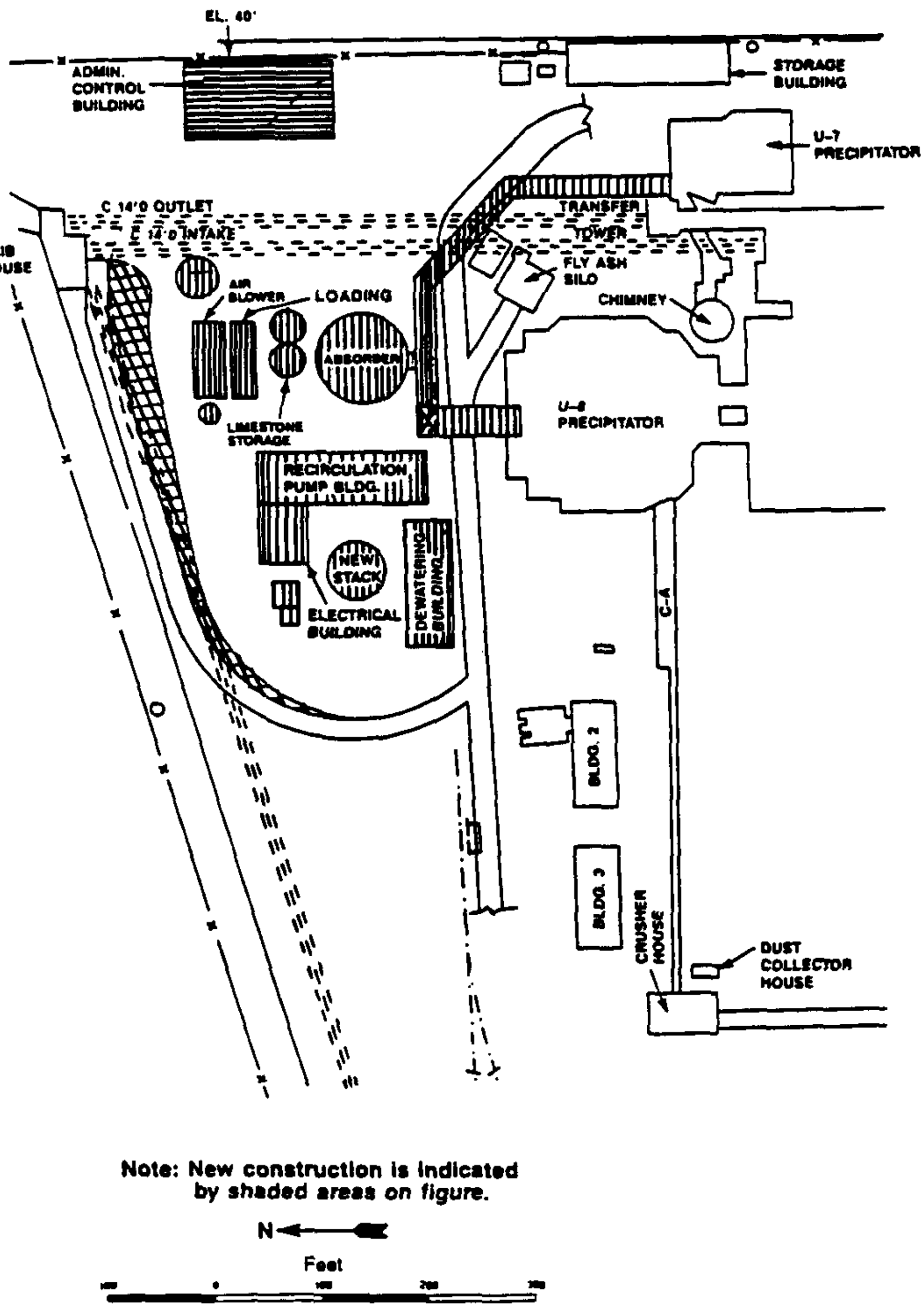

Figure 7. Plot plan of the proposed advanced flue gas desulfurization system.
Source: Pure Air, *Bailly Generating Station advanced Flue Gas Desusfurization System Final Environmental Information Volume*, Allentown, Pa., 1989.

The Bailly plant typically withdraws about 9 million gal/h, but it may withdraw up to 18 million gal/h for once-through cooling water. The cooling water is withdrawn from a crib located about 1500 ft offshore and is returned to the lake through a 300-ft flume at the shore. The AFGD system requires about 90,000 gal/h of water for process, cooling, and pump seal. In addition, intermittent uses of water by the AFGD system include potable water, fire protection water, and quench water. Potable water (up to 4,200 gal/h) is supplied from the existing potable water line. The fire protection water (60,000-gal/h capacity) and the quench water (35,000-gal/h capacity) are provided by Bailly Generating Station's high-pressure service water system. Up to 32 tons/h of limestone and 28.7 lb/h of hydrated lime are consumed by the AFGD system.

Operation, maintenance, and management of the AFGD system will require 25 to 30 personnel. Construction will require about 340 person-years of labor by various crafts.

2.1.3.5 Emissions, effluents, and wastes

The AFGD system is expected to be capable of reducing the SO_2 emission rate by 90%, which would result in an emission rate of about 0.5 lb of SO_2 per million Btu. Pure Air has guaranteed Northern Indiana Public Service company a 90% reduction in SO_2 emissions. In discussions with IDEM, Northern Indiana Public Service Company has offered to meet a permitted emission rate of 1.2 lb/million Btu rather than a reduction of 90% to allow flexibility in AFGD system operations. The 1.2 lb/million Btu emission rate is also a value that has been proposed in acid precipitation control legislation. This emission rate would be acceptable to IDEM only if all regulatory requirements are met, including atmospheric dispersion modeling results that indicate compliance with the National Ambient Air Quality Standards (NAAQS) (Sect. 4.1.2.).

The process will not reduce or increase the current NO_x or particulate matter stack emission rates; however, the 7.6 MW required to operate the AFGD system will reduce the net efficiency of the plant and will require consumption of about 2% more coal to produce the same net amount of electricity. Consequently, annual NO_x and particulate emissions could increase by as much as 2%.

The main by-product of reducing SO_2 emissions will be the production of 500 to 700 tons of gypsum per day. The gypsum is expected to be suitable for manufacturing wallboard and is expected to be sold to one or more wallboard manufacturers. Table 3 presents the anticipated composition of the AFGD gypsum and commercial requirements for marketing it. Pure Air is facilitating negotiations between Northern Indiana Public Service Company and walboard producers (Pure Air 1989a); however, if the gypsum could not be sold, it would become solid waste that must be landfilled.

Table 4 lists the characteristics of wastewater expected to be generated by the AFGD system when the WES is not in operation. Demonstration and operation of the project would generate small amounts of additional sanitary wastewater.

When the WES is operating, the AFGD system wastewater discharges would be 47 gal/min (60% less than shown in Table 4). However, as much as 1,200 lb/h of additional solids would be added to the fly ash while the WES is being tested (Mr. F. T. Bolinsky, Senior Project Manager, Pure Air, letter to Mr. Thomas Sarkus, DOE, Pittsburgh Energy Technology Center, Pittsburgh, Penn., Aug. 22, 1989). WES solids are expected to contain about 60% chlorides by weight. The WES testing is expected to occur over a 3- to 6-month period during the 3-year demonstration, but the schedule and duration of the tests have not been set.

Table 3. Anticipated gypsum composition and wallboard manufacturer's requirements

Parameter	Manufacturer requirement	Expected range AFGD system
$CaSO_4 \cdot 2H_2O$	93% min.	93 to 95%
$CaSO_3 \cdot \frac{1}{2}H_2O$	2% max.	0.5 to 2%
SiO_2	2.5% max.	1 to 3.5%
Fe_2O_3 (and other metal oxides)	3.5% max.	2 to 3.5%
Free H_2O	10% max.	8 to 10%
pH	5 to 8	6

Source: Letter to Mr. F. T. Bolinsky, Senior Project Manager, Pure Air to Mr. Thomas Sarkus, U.S. Department of Energy, Pittsburgh Energy Technology Center, Pittsburgh, Aug. 22, 1989.

Table 4. Anticipated composition of advanced flue gas desulfurization system wastewater when the wastewater evaporation system is not in operation

Total flow		117 gal/min
Total suspended solids		5.6 wt %
$CaSO_4 \cdot 2H_2O$		5.15 wt %
Fly ash and other solids		0.45 wt %
Dissolved solids	Ca^{++}	7,200 mg/L
	Mg^{++}	4,000 mg/L
	$SO_4^{=}$	1,300 mg/L
	Cl^-	23,000 mg/L
	F^-	1,100 mg/L
	$S_2O_6^{=}$	600 mg/L

Source: Pure Air 1989a.

2.2 ALTERNATIVES TO THE PROPOSED ACTION

Alternatives were considered through all three elements of the NEPA strategy (Sect. 1.3). No action was considered in the programmatic analysis, as well as in the preparation of this document, while delayed action was considered primarily in the preselection review. Alternative sites and alternative technologies for the CCTDP were considered in the preselection review. A summary of the alternatives is provided below.

2.2.1 No Action

No action on the proposed project would be a decision by DOE not to provide funds for the project beyond preliminary design. Emissions of SO_2 would not be reduced, and ICCT program demonstration of this technology would not take place at this time. The technology may then not become commercially available as an alternative to existing technologies, unless demonstrated by the private sector.

2.2.2 Delayed Action

Delaying the installation and operation of the proposed project would delay the reduction of emissions of SO_2 from the Bailly Generating Station. Similarly, this also could delay the availability of data on this technology and the introduction of a cost-effective alternative to emissions control.

2.2.3 Alternative Sites

Northern Indiana Public Service Company owns three power generating sites on the shores of Lake Michigan: Michigan City, Mitchell and Bailly. The site features that were important in the site selection process included the demonstration of single absorber operation using flue gases from multiple boilers, the possibility of future emissions reductions requirements, and access to transportation. The Michigan City site would not allow demonstration on flue gases from multiple boiler operation. The Mitchell site, which is about 15 miles west of the Bailly site, was originally considered as the possible site for the project. However, the Mitchell site received a favorable ruling in state air permit renewal regarding allowable emissions of sulfur dioxide, and this ruling made locating the project there uneconomical. In addition, the possible reductions in emissions were much greater at the Bailly site (70,000 tons/year versus 8,000 tons/year at the Mitchell site) because of the difference in currently allowable emission rates of the two plants (6.0 lb/million Btu at Bailly vs 1.2 lb/million Btu at Mitchell).

2.2.4 Alternative Technologies

Commercially available flue gas desulfurization technologies could be used at the Bailly site to reduce emissions. However, gypsum producing systems are the only commercially competitive processes that produce a consistently salable by-product. The proposed AFGD system is expected to be capable of reducing emissions of SO_2 by 90% in a cost-effective manner while producing a salable gypsum instead of a solid waste as produced by most flue gas desulfurization systems. In addition, the wastewater evaporation system being demonstrated as part of this project has the potential to eliminate wastewater discharges, thereby limiting the wastes generated to ash and a small quantity of evaporated salts.

Other innovative control technologies are capable of similar economic and technological advantages over commercially available processes. To the extent that these technologies are ready for commercial demonstration, they are being demonstrated in other projects of the Clean Coal Technology Program.

3. AFFECTED ENVIRONMENT

3.1 CLIMATE AND AIR QUALITY

3.1.1 Climate

The climate surrounding the Bailly Generating Station is continental, characterized by high winds and frequent weather changes. The area is subject to cold, dry winters and warm, moist summers. The average temperature for the area is approximately 50°F and ranges from 24°F in January to 73°F in July. Record low and high temperatures for Ogden Dunes, Indiana, located 4 miles to the southwest of Bailly, are -21°F and 104°F (Gale Research Company 1985).

The area is known for frequent high winds; however, damaging winds are rare. During a 10-year period, 20 tornadoes were identified and reported in the 1° latitude and longitude box containing the plant site. Using the Thom (1963) technique, the expected frequency for a tornado striking Bailly is once every 635 years.

There are important climatological differences between dune areas, which include the plant site, and more urban inland areas. The effect of Lake Michigan and urban areas on precipitation is more pronounced farther inland than along the dune areas. For example, Ogden Dunes receives only 36 inches of precipitation (rain and melted snow) per year, while Valparaiso, about 11 miles to the southeast, averages 39 inches of precipitation per year. Also, sites close to Lake Michigan tend to have a smaller daily temperature range than do more inland sites. Figure 8 summarizes the annual frequencies of wind direction and speed from the Dune Acres substation, located 1.4 miles southeast of Bailly Generating Station, for the period from 1984 to 1986. Prevailing winds are from the southwest, with frequent winds from the northeast.

3.1.2 Air Quality

Existing ambient air quality in the vicinity of the Bailly Generating Station is generally indicative of the highly industrialized nature of the area. Currently, Porter County is classified as being nonattainment for ozone. The county was also a nonattainment area for total suspended particulate matter (TSP) and is now in an "uncertain" status for particulate matter less than 10 μm (PM_{10}). All other criteria pollutants (SO_2, nitrogen dioxide, carbon monoxide, and lead) are in attainment. Portions of La Porte County (immediately to the east of Porter County) are classified as nonattainment for SO_2 (Ken Ritter, IDEM, Indianapolis, Ind., personal communication with Mark Mitckes, EBASCO Services Inc., Oak Ridge, Tenn., Sept. 6, 1989).

The Bailly Generating Station is located adjacent to Bethlehem Steel's Burns Harbor Plant and Midwest Steel. Steel mills emit a large amount of SO_2 to the air. The emissions from Bailly Generating Station, the nearby steel mills, and other industries in the area contribute to the ambient concentration of SO_2 in the area.

Recently, the IDEM conducted a study to develop a control strategy for meeting and maintaining the NAAQS for SO_2. Results of this study indicated that the NAAQS for SO_2 are being met; however, the predicted concentrations were very close to the standards.

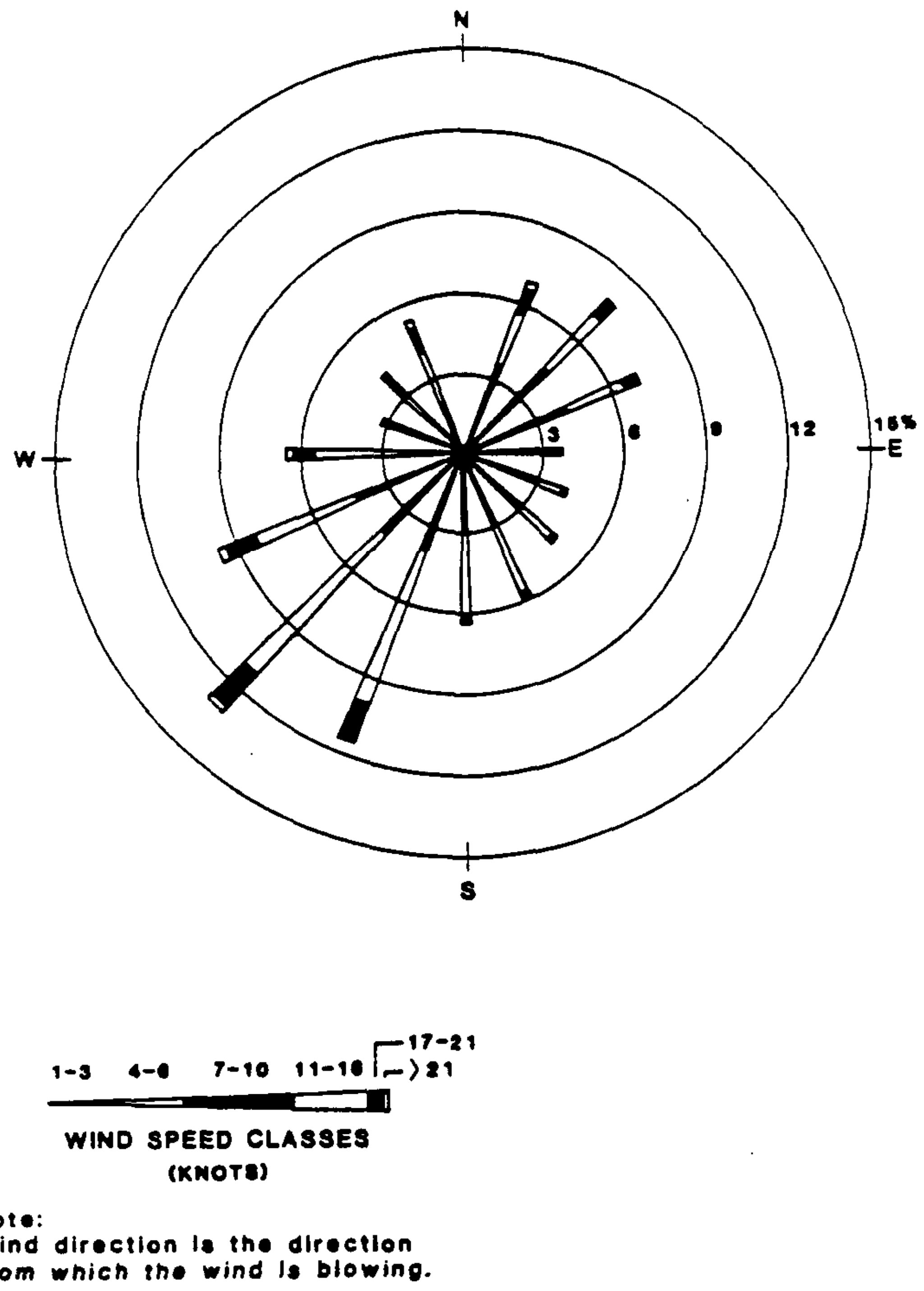

Figure 8. Wind rose for Dune Acres, Indiana, 1984 through 1986. *Source*: Pure Air, *Baily Generating Station Advanced Flue Gas Desulfurization System Final Environmental Information Volume*, Allentown, Pa., 1989.

Northern Indiana Public Service Company has collected air-quality data at the Bailly Generating Station for more than ten years. The Bailly Ambient Air Monitoring Network was modified January 1, 1989, and now has been incorporated into the Porter County SO_2 Monitoring Network. Northern Indiana Public Service Company now operates three SO_2 monitoring sites within the Porter County SO_2 monitoring network (Pure Air 1989a). Table 5 summarizes monitoring data collected at these and other nearby monitoring stations operated by the IDEM.

Table 5. Summary of 1988 ambient monitoring data collected near Bailly Generating Station

Pollutant interval	Monitoring site	Distance (miles)	Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
PM_{10}	East			
24-h	office	1.2 SE	73[a]	150[b]
	Bethlehem			
Annual[c]	Steel	1.2 SE	32	50
SO_2				
3-h	Dune Acres Substation	1.4 SE	430[a]	1,300[b]
24-h	"	1.4 SE	182[a]	365[b]
Annual[d]	"	1.4 SE	26	80
NO_x				
Annual[d]	Calumet City, Ill.	22 W	46	100

[a]Second highest concentration.
[b]Not to be exceeded more than once per year.
[c]Geometric mean.
[d]Arithmetic mean.
Source: Ritter K., IDEM, Indianapolis, Ind., monitoring data sent to M. Mitkes, EBASCO Services Inc., Oak Ridge, Tenn., Sept. 13, 1989.

Northern Indiana Public Service Company continuously monitors the plume opacity from the Bailly Generating Station stack. Periodic stack tests also are conducted to determine emission rates for SO_2 and particulate matter. The existing air permit allows for an emission rate of 6.0 lb/million Btu for SO_2, 0.22 lb/million Btu for particulate matter and an opacity limit not to exceed 40%. Annual SO_2 emissions are about 70,000 tons. Annual particulate and NO_x emissions in 1988 at Bailly Generating Station were estimated at 527 tons and 23,310 tons, respectively (M. T. Maassel, Manager, Environmental Programs, Northern Indiana Public Service Company, Hammond, Ind., letter to Lance McCold, ORNL, Oak Ridge, Tenn., Sept. 15, 1989.) Monthly summary data of Bailly Generating Station average opacity levels from August 1988 through August 1989 show that the monthly average opacity varied from 6 to 17%. Monthly exceedances of the 40% opacity level occurred between 0.01 and 0.24% of the time (M. T. Maassel, Manager, Environmental Programs, Northern Indiana Public Service Company, Hammond, Ind., letter to Lance McCold, ORNL, Oak Ridge, Tenn., Sept. 15, 1989). Bailly Generating Station's operating permit allows up to 10 6-min exemptions from the 40% opacity limit during boiler startup and shutdown (Pure Air 1989a).

3.2 SURFACE WATER

The Bailly power plant is located on the southern shore of Lake Michigan. Drainage at the proposed project site is primarily northward toward Lake Michigan, which is approximately 600 ft from the site. Drainage from the site is normally via percolation through the sand substrate. Culverts and drainage ditches are not required because of the high permeability of the soil.

The waters of the southern shore of Lake Michigan are used for recreation, including swimming and fishing; municipal and industrial water supply; and assimilation of waste, including municipal and industrial wastewater and cooling water. Lake Michigan, which has a surface area of 22,300 $miles^2$, a volume of 1200 $miles^3$ and a shoreline of 1,660 miles, maintains relatively good water quality. Impacts to the quality of the water of Lake Michigan in the project vicinity include numerous industrial discharges, both directly to the lake and to streams that enter the lake.

The Little Calumet River and its tributary drainage canals drain lands south and west of the plant. The Little Calumet River is connected to Lake Michigan by the Portage-Burns Waterway approximately 2.8 miles southwest of the plant. Also, many ponds and wetlands are in the plant vicinity (Sect. 3.5). However, because none of these streams, ponds, or wetlands is closer than about 0.3 mile to the proposed project, and because of the high permeability of the soil and the site topography, surface runoff cannot reach any surface water body except Lake Michigan.

3.3 GEOHYDROLOGY

3.3.1 Geology

The geology at the southern shore of Lake Michigan represents a complex history of glacial, shallow-water coastal, lake, wetland, and beach/dune sedimentation that began during and after the final stages of glacial retreat from the Great Lakes area approximately 12,000 years ago. In the subsurface of the Indiana Dunes region, three distinct sedimentary units (the basal, middle, and surface units) have been described by Thompson (1987). The basal unit consists of randomly interbedded clay, sand and gravel, and till, which rest on an irregular Paleozoic bedrock surface that is approximately 4000 ft thick. The thickness of this lowermost lithologic unit is highly variable due to relief on the underlying bedrock and later erosion of the sediments.

The middle unit consists of an assemblage of interbedded till, glacial/lake clay, and sand and gravel. This unit crops out in the region as the Lake Border Moraine. The glacial/lake deposits are well developed northward within this unit where it extends under Lake Michigan, and the till deposits of the middle unit are more common to the south of the lake. Glacial till is exposed on the surface of the Lake Border Moraine, whereas the core consists of till interbedded with sand and gravel.

The surface unit, an outcropping along the southern shore of Lake Michigan, consists of coastal sand with minor gravel, clay, calcareous mud, and peat. From south to north, these sediments form the Glenwood, Calumet, and Tolleston beaches and interridge marshes. This series of beach/dune complexes began forming between 14,500 and 12,400 years ago in response to rises and falls in lake level and changes in the amount of sediment supplied to the coastline (Thompson 1987).

3.3.2 Groundwater

Three major aquifers are present within the unconsolidated sediments surrounding the Bailly Generating Station (Figure 9). The lowermost aquifer, the basal sand aquifer, is a confined unit comprised of discontinuous sandy zones within Thompson's (1987) basal unit. This aquifer appears to be thicker eastward of the Bailly Generating Station, although the extent of the aquifer is not well defined.

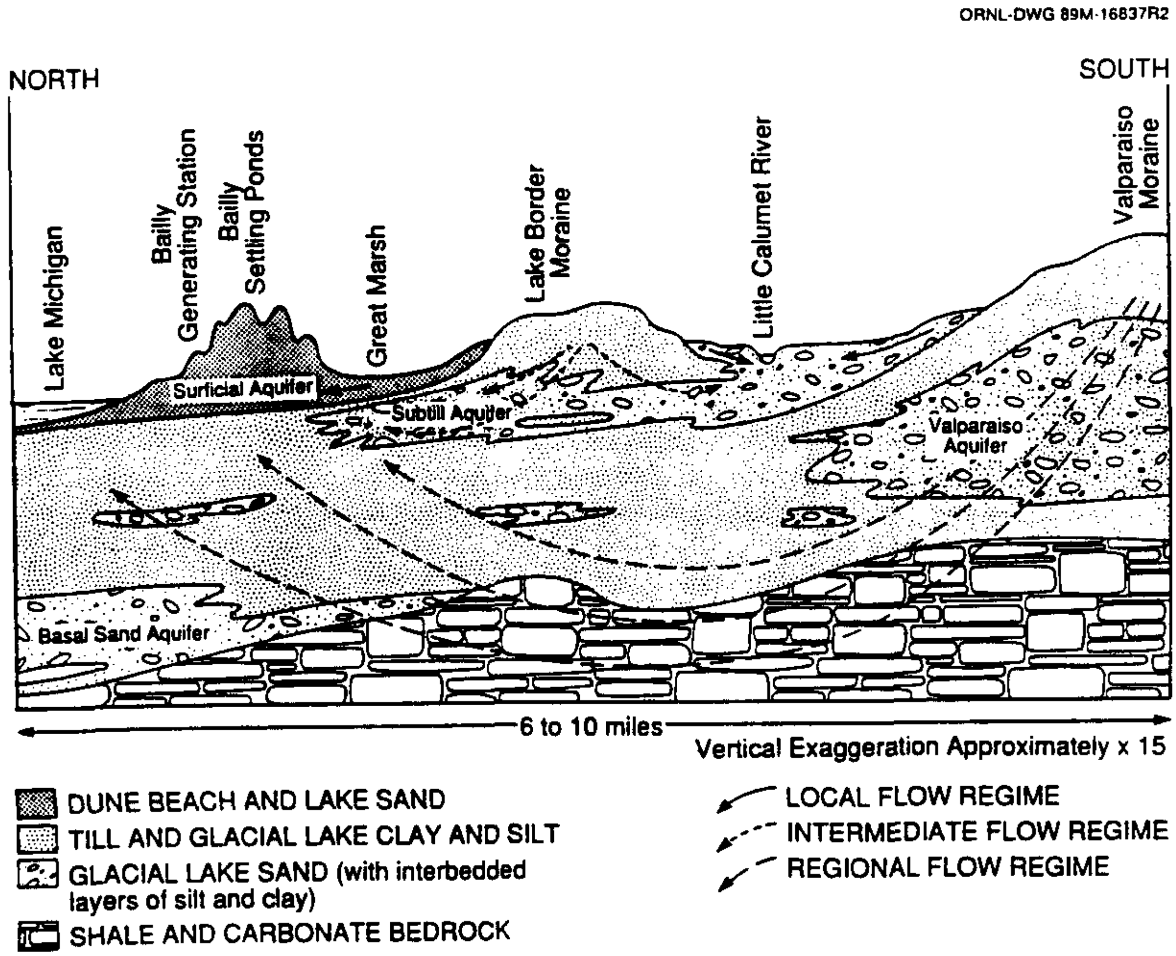

Figure 9. Cross-section perpendicular to the Lake Michigan shoreline showing geology and groundwater movement near the Bailly Generating Station.
Sources: Cohen 1989; Thompson 1987; Pure Air 1989a.

The most extensive confined aquifer in the area, the subtill aquifer, consists primarily of sand with interbedded lenses of clay. The subtill aquifer, part of Thompson's (1987) middle unit, underlies virtually the entire area of the Lake Border Moraine and extends north of the moraine into the Great Marsh (the interdunal wetland between the Calumet and Tolleston beaches) (Figure 9).

The most extensive aquifer in the area adjacent to the Bailly Generating Station is the surficial aquifer (Figure 9), which consists of lake, beach and dune sand deposits. The surficial aquifer is developed in all areas adjacent to Bailly Generating Station, except where glacial moraines are exposed at the surface. In the vicinity of the Bailly Generating Station, the surficial aquifer is over 50 ft thick (D. A. Cohen, U.S. Geological Survey, Indianapolis, Indiana, personal communication to D. G. Jernigan, ORNL, Oak Ridge, Tenn., Sept. 18, 1989).

Groundwater flow in the region may be divided into regional, intermediate, and local flow systems, as illustrated in Figure 9. The regional groundwater flow system originates at water table highs in the Valparaiso Moraine, several miles south of the study area. Groundwater in this regional system flows down through the glacial deposits under the Valparaiso Moraine, into the upper bedrock, and then laterally through the bedrock toward Lake Michigan.

The intermediate flow system originates at the water-table high in the Lake Border Moraine and extends down through the underlying subtill aquifer and flows northward, where it discharges by upward leakage into drainage systems in the Great Marsh.

Local flow systems within the surficial aquifer are recharged in the dune-beach complexes and discharge into streams, ditches, and ponds in the interdunal wetlands. The shallow groundwater flow system is typified by broad, flat, water-table mounds that function as groundwater flow divides underlying the topographical high dune-beach complexes. Shallow groundwater flows northward or southward from these divides and discharges into adjacent low-lying areas and wetlands. The Bailly Generating Station is located north of the water table divide underlying the shoreline dune-beach complex (Figure 9); thus, the shallow groundwater flows directly into Lake Michigan at an estimated rate of approximately 0.5 ft/d (D. A. Cohen, U.S. Geological Survey, Indianapolis, personal communication to D. G. Jernigan, ORNL, Oak Ridge, Tenn., Sept. 18, 1989; Pure Air 1989).

From 1967 to 1980, fly ash produced during operation of Bailly Generating Station was collected by ESPs and transported as a slurry to a series of unlined settling ponds located on the southeastern part of the plant site. The settling ponds were periodically drained, and the accumulated ash was removed and used as fill for an area on the east side of the site (Hardy 1981). Based on evaluation of monitoring wells in the area, Meyer and Tucci (1979) determined that seepage from these ponds, estimated at 2 Mgd, created a groundwater mound that extended into the property of the Indiana Dunes National Lakeshore and caused several lowlands within a dune field north of the settling ponds to be flooded year-round. This seepage mound acted as a north-south flow divide in the vicinity of the Bailly Generating Station (Cohen and Shedlock 1986). In late 1979, the facility discontinued use of the easternmost settling pond, which was dewatered, dredged, and backfilled with sand and in 1980 and 1981, the remaining settling ponds were sealed by lining with a 1-ft-thick layer of clay and a 0.12-inch-thick polyvinylchloride liner (Cohen and Shedlock 1986).

Sealing these ponds changed the shallow groundwater flow at the site. The artificial north-south groundwater divide created by pond leakage has been eliminated, allowing lowlands within the dune field north of the settling ponds to dry (Cohen and Shedlock 1986). The seepage mound created by the unlined settling ponds extended no farther than about 3000 ft from the ponds. This fact suggests that seepage from the settling ponds before sealing did not affect water levels in the Great Marsh (Cohen and Shedlock 1986).

3.3.3 Groundwater Quality

The quality of groundwater in the vicinity of Bailly Generating Station was investigated by Hardy (1981) from September 1976 to May 1978, a period before the settling ponds were sealed. He noted that the artificial shallow groundwater mound north of the settling ponds contained elevated levels of calcium, sulfate, potassium, and some trace constituents (boron, cadmium, fluoride, iron, manganese, molybdenum, nickel, zinc, arsenic, and strontium) relative to background levels outside the mound area. Since the settling ponds were sealed, the concentration of some of these constituents in the shallow groundwater aquifer has decreased. However, the concentrations of some of the constituents show no consistent trends, but remain above background levels. Cohen and Shedlock (1986) suggest that the constituents remaining at concentrations above background had previously sorbed or precipitated onto aquifer materials and are now being leached back into the groundwater. Hardy (1981) determined that seepage of wastewater from the Bailly Generating Station settling ponds did not appreciably affect water chemistry in the deeper aquifer systems (confined aquifers) beneath the plant.

3.4 ECOLOGY

3.4.1 Terrestrial

The site for the proposed AFGD project contains only a scant amount of vegetation on the north-facing slope which will be filled. Because of the minimal vegetation cover, it is unlikely that the area serves as habitat for many animal species.

The last major Pleistocene glaciation, the Wisconsinian, created most of the present-day landforms and drainage patterns in the area at the southern end of Lake Michigan (DOI 1979). Fluctuations in the level of Lake Michigan during the past 13,000 years have created a series of lake shorelines, all of which are represented to some degree in the Indiana Dunes National Lakeshore.

Vegetation in the Indiana Dunes region has developed in response to these topographic and soil factors. The chief terrestrial communities in the area are the sand beach and dune systems, which grade into forests farther inland. Several detailed studies of these communities and their successional phases from bare sand beach to climax forest have occurred during the past 100 years (Cowles 1899; Olson 1958; DOI 1979). Specific noteworthy vegetation communities within the national lakeshore include Miller Woods, Hoosier Prairie, Pinhook Bog, and Cowles Bog (the latter three are national natural landmarks). Another national natural landmark in the area, Dunes Nature Preserve, is located in Indiana Dunes State Park.

Many of the larger animals that were once abundant in this region (e.g., moose, bear, bobcat, buffalo, and wolf) are no longer found here (DOI 1979). The most common animals are the smaller mammals, birds, amphibians, reptiles, and insects. In areas that have good cover of large vegetation, vertebrates predominate, while invertibrates predominate in open sand and lightly grassed areas.

3.4.2 Aquatic

The various surface waters in the project vicinity support a diversity of aquatic life. Lake Michigan has supported a variety of important prey and game fish species; the abundance of these species has changed historically with accidental introductions and changes in fisheries management. Currently, coho and chinook salmon and yellow perch provide important game fisheries, and the alewife is a dominant prey species. Sport fishing from boats near the Bailly Generating Station's cooling water discharge is popular. Salmon stocked in the Little Calumet River propagate in Lake Michigan and return to this river to attempt spawning. Primary production in Lake Michigan is generally low, and algal blooms generally do not occur. Zooplankton in the lake are diverse, and the abundance of zooplankton is much higher in the cooling water discharge from the Bailly Generating Station than in adjacent waters (Northern Indiana Public Service Company 1973).

The smaller ponds and wetlands in the area have generally higher primary productivity than Lake Michigan, presumably due to higher summer water temperatures, shallower depths, and higher nutrient loadings. Fish in the ponds are characteristically warm water species such as green sunfish, central mudminnow, and black bullhead.

On a broader scale, many aquatic ecosystems of the northeastern United States and eastern Canada are affected by changes in water quality that result from airborne emissions from large coal-fired power plants such as the Bailly Generating Station. Acidification of some surface waters has decreased the number of species present in these waters. The relationship between coal-fired power plants, flue gas desulfurization technologies, and impacts to aquatic ecosystems has been analyzed by DOE (1989). DOE's analysis shows that widespread implementation of desulfurization may eventually mitigate some ecological impacts of acidification.

3.4.3 Threatened and Endangered Species

Because of the industrial, disturbed nature of the site, no threatened or endangered species (proposed or listed) or any proposed or designated critical habitats are expected to be found on the project site.

No aquatic species in the immediate vicinity of Bailly Generating Station (in Lake Michigan, the Little Calumet River and tributaries, or in ponds) are listed as threatened, endangered, or otherwise specially protected by the federal government or by Indiana.

Two federally listed threatened and four federally listed endangered terrestrial species could be found in the Indiana Dunes National Lakeshore (Table 6). The three bird species are migrants that do not nest in the local area.

The normal habitat of the Indiana bat (*Myotis sodalis*) and the gray bat (*M. grisescens*) includes caves. In summer Indiana bat maternity colonies are found mostly in riparian and floodplain forests near small- to medium-sized streams, while males are occasionally found in caves (Barbour and Davis 1969; DOI 1979; DOE 1983; Clawson 1987). Although the occurrence of the two bat species in the Indiana Dunes is unlikely (there are no caves in the area), the Indiana bat might be present in the summer. However, because there is no riparian forest habitat in the area, the bat is unlikely to be found there.

Table 6. Federally listed threatened and endangered species found in the Indiana Dunes National Lakeshore

Species	Status
Dune thistle *(Cirsium pitcheri)*	Threatened
Kirtland's warbler *(Dendronica kirtlandii)*	Threatened
Peregrine falcon *(Falco peregrinus)*	Endangered
Bald eagle *(Haliaeetus leucocephalus)*	Endangered
Indiana bat *(Myotis sodalis)*	Endangered
Gray bat *(M. grisescens)*	Endangered

Source: Pure Air 1989a.

The dune thistle, a species endemic to shorelines of the Great Lakes, is found at all three Great Lakes national lakeshores—Indiana Dunes, Sleeping Bear Dunes, and Pictured Rocks (McEachern et al. 1989). The dune thistle is restricted to a narrow habitat in the loose sands of the outer dunes. Population dispersion at Indiana Dunes is disjunct, with very low numbers of populations and a greatly depressed number of flowering plants relative to the other two lakeshores. The closest identified population to the proposed project is a little more than about 0.6 mile to the east-northeast (McEachern et al. 1989).

In addition, numerous plants and animals found at the Indiana Dunes National Lakeshore are on the Indiana list of rare, threatened, and endangered species (Pure Air 1989a). Many of these are uncommon in Indiana because their distribution is restricted to the Great Lakes shoreline, which has minimal occurrence in the state, and are at the edges of their ranges (Noel Pavlovic, U.S. National Park Service, personal communication with Martha S. Salk, ORNL, Oak Ridge, Tenn., October 4, 1989). Therefore, many of these species, while rare in Indiana, are not considered to be rare within their entire range (Cloyce Hedge, Indiana Natural Heritage Program, personal communication with Martha S. Salk, ORNL, Oak Ridge, Tenn., October 10, 1989). While there is minimal legal protection for these species, National Lakeshore personnel treat all of them as though they were federally threatened (Noel Pavlovic, U.S. National Park Service, personal communication with Martha S. Salk, ORNL, Oak Ridge, Tenn., October 4, 1989). The national lakeshore has a monitoring system in place for the state-listed plants (Bowles 1989) but none for the animals.

3.5 FLOODPLAINS AND WETLANDS

Lake Michigan is the body of water closest to the project site. The 100-year flood elevation of Lake Michigan, as determined by the Federal Emergency Management Agency for Porter County, Indiana, is 584 ft above mean sea level. The approximate mean lake level is 580 ft. The proposed project site is at an elevation of about 620 ft, or approximately 40 ft above the 100-year flood elevation.

There are no wetlands on the Bailly Generating Station site except for the Lake Michigan shore, which supports no wetland vegetation in this area. There are, however, numerous wetlands in the Indiana Dunes area, including some near the plant. Most of the wetlands in the dunes are classified as palustrine, including marshes (wetlands dominated by herbaceous plant species), swamps (which are dominated by trees), bogs (where vegetation floats in mats on the water), and ponds (DOI 1979). There are also lacustrine wetlands along the Lake Michigan shoreline and riverine wetlands along the Little Calumet River and tributaries.

Cowles Bog, a wetland complex of special concern because of its biological and scientific importance, is a national natural landmark inside the national lakeshore. It is immediately to the east of the Bailly Generating Station boundary, although it is more than 2000 ft from the site of the proposed AFGD project. Cowles Bog contains shrub, forested, cattail and sedge grass wetlands (Wilcox et al. 1986). The areas of these different wetland types have changed over time as a result of hydrologic modifications such as the installation and subsequent lining of the wastewater ponds at the Bailly Generating Station (Wilcox et al. 1984) (Sect. 3.3). A number of plant and tree species that are rare in Indiana occur at Cowles Bog. Cowles Bog has been studied by numerous researchers. Wilcox et al. (1984 and 1986) have described the bog complex and its history of changes.

3.6 SOCIOECONOMICS

3.6.1 Population, Demography, and Economy

The 1989 population within 5 miles of the Bailly Generating Station is approximately 42,000 (Pure Air 1989a). The incorporated areas within 5 miles are presented in Table 7. Bailly Generating Station is located at the northern edge of Porter County. Porter and Lake counties comprise the Gary-Hammond Primary Metropolitan Statistical Area (PMSA), which had a 1984 population of about 630,000. The Gary-Hammond PMSA is within the Chicago–Gary–Lake County Consolidated MSA, which had a 1984 population of about 8,000,000. Although the greater Chicago area population grew by 1.2% from 1980 to 1984 and the Gary-Hammond area declined by 2% over the same period, Porter County grew by 4.3% (U.S. Bureau of the Census 1986).

The Porter County economy is oriented toward steel production as is the larger Gary-Hammond area. Unemployment rates in the local and regional area were extremely low in July 1989: 2.2% unemployment in Porter and 3.8% for the Gary-Hammond PMSA. Per-capita income in Porter County was $14,404 in 1987, which was above the statewide average of $13,935 (Keith Kunze, Labor Market Analysis Administrator, personal communication with J. Van Dyke, ORNL, Oak Ridge, Tenn., September 8, 1989). The economy's reliance on the steel industry suggests that the economic outlook will be very closely related to national swings of the business cycle. Table 8 lists the major manufacturing activities within a 5-mile radius of the Bailly Generating Station.

3.6.2 Infrastructure, Transportation, Housing, and Public Services

The Bailly operations station uses Lake Michigan as a source of its nonpotable water and for discharging wastewater after it is treated. Potable water is supplied from Hobart Water Corporation through a Bethlehem Steel water line. There are on-site sewage and wastewater treatment facilities. Sludge from these operations is hauled out by truck and disposed of at off-site landfills. Currently, sludge from the sewage treatment facility is hauled by contractor to Portage City Municipal Treatment Plant. Sanitary solid waste and sludge from the wastewater treatment plant are hauled by truck to Wheeler landfill, which is between Valparaiso and Hobart and State Road 130 (M. T. Maassel, Manager, Environmental Programs, Northern Indiana Public Service Company letter to Lance McCold, ORNL, Oak Ridge, Tenn., September 15, 1989).

Table 7. Populations of incorporated communities within 5 miles of the Bailly Generating Station

Community	Distance (miles) and direction	1980 population
Dune Acres	2.0 ENE	291
Burns Harbor	2.5 SSW	920
Porter	3.2 SE	3,441
Ogden Dunes	3.5 WSW	1,489
Portage	4.5 WSW	30,300[a]
Chesterton	4.5 SE	8,531
Porter County	-	131,000[a]

[a]1984 estimate.

Source: 1986 Rand McNally Commercial Atlas and Marketing Guide, 117th Edition, Rand McNally & Company, Chicago, 1986.

Table 8. Manufacturing firms with 100 employees or more within a 5-mile radius of the Bailly Generating Station

City	Company	Activity	Employees
Chesterton	Bethlehem Steel (Burns Harbor)	Steel mill	6200
Chesterton	Lukria Brothers	Scrap metal	122
Chesterton	Manley Brothers	Stone, clay and glass products	125
Portage	Bethlehem Steel	Steel mill	6000
Portage	The Levy Co.	Stone, clay and glass products	300
Portage	Metro Metals Co.	Steel foundry	150
Portage	National Steel Co. (Midwest Div.)	Steel mill	1700

Source: Pure Air 1989a.

Bailly is within the jurisdiction of the Porter County Sheriff's Department. Fire protection is provided by trained volunteers from the Bailly Generating Station work force. The Porter Fire Department would be the first to respond if outside support is required.

Bailly Generating Station has ready access to rail, highway, and water transportation. The principal highways within 10 miles of the station include Interstates 80, 90, and 94 and Highways 20, 12, and 6. These highways all run east-west. Interstate 65, to the west, runs south from Gary, Indiana. Highway 12, also known as the Dunes Highway, is a two-lane highway that runs along the southern border of the site boundary. The Chicago South Shore and South Bend Railroad also runs east-west along the Bailly Generating Station boundary. Bailly Generating Station also can be reached by water at its northern boundary on Lake

Michigan, although it does not use water transportation. Coal is brought in by train and ash and other wastes are removed by truck.

An access road (Bailly Generating Station Road) that intersects Highway 12 is the only vehicle entrance to Bailly Generating Station. The first portion of this access road also is used by Bethlehem Steel, mainly for truck traffic entering and leaving the Bethlehem Steel plant to the southwest of Bailly Generating Station. This section of the access road becomes congested during the morning and evening rush hours. Although this access road is not the main entrance for Bethlehem Steel workers, a substantial number use it, along with approximately 200 Bailly operating employees. Bailly Generating Station and Bethlehem Steel employees work approximately the same shift hours. The Chicago South Shore and South Bend railroad may cause intermittent traffic delays throughout the day as passenger and coal train traffic crosses the access road (Gary Logan, Senior Environmental Specialist, Northern Indiana Public Service Company, telephone conversation with J. W. Van Dyke, ORNL, Oak Ridge, Tenn., September 14, 1989). No traffic counts have been taken at the intersection of Highway 12 and Bailly Generating Station Road (Marsha Gustafson, Indiana Department of Transportation, telephone conversation with J. W. Van Dyke, ORNL, Oak Ridge, Tenn., September 18, 1989).

More than 30 public schools with a total enrollment of over 20,000 students, are within a 12-mile radius of the site. The closest school is in Porter, and it had a 1988 enrollment of 353 (Pure Air 1989a). Six hospitals with a total of about 1400 beds are within a 12-mile radius of the site. The housing vacancy rate was 2.2% for Porter County in October 1988 and 3.5% for the Gary–Hammond–East Chicago (PMSA) (Federal Home Loan Bank of Indianapolis 1988).

3.6.3 Ambient Noise

The nearest residence is 1.5 miles from the proposed site of the AFGD system. The Indiana Dunes National Lakeshore Park is separated by a 300-ft greenbelt from the nearest Bailly Generating Station building. The Bailly Generating Station access road is within 300 ft of the western boundary of Indiana Dunes National Lakeshore Park.

Pure Air conducted a survey of noise levels in the westernmost part of the Indiana Dunes National Lakeshore near Bailly Generating Station (F. T. Bolinsky, Senior Project Manager, Pure Air, letter to Thomas Sarkus, DOE, Pittsburgh Energy Technology Center, Pittsburgh, Penn., November 16, 1989). The survey found current noise levels of 58 to 61 dBA about 15 ft east of the greenbelt fence that separates Indiana Dunes National Lakeshore from Bailly Generating Station property. About 400 ft east of the fence, noise levels of 57 to 60 dBA were measured. Sound levels between 56 and 61 dBA were measured at about 900 ft east of the fence. The slow decline of noise levels with distance suggests that the dominant noise sources are farther from the national lakeshore than is Bailly Generating Station.

The Bailly Generating Station has ambient noise levels typical of electric generation activities. Noise levels on the Bailly Generating Station (with Unit 7 operating at 60% capacity) have been found to range from 54 to 63 dBA at distances of 300 ft or more from the generating facilities (F. T. Bolinsky, Senior Project Manager, Pure Air, letter to Thomas Sarkus, DOE, Pittsburgh Energy Technology Center, Pittsburgh, Penn., November 16, 1989).

3.7 LAND USE

The Bailly Generating Station is situated in northern Porter County, 12 miles northeast of the center of Gary, Indiana. The Bailly Generating Station site consists of about 300 acres of land. On-site land uses are related to coal-fired electric generation activities, including buildings housing the steam boilers and generating equipment, a coal storage area, holding ponds for wastewater treatment, a conveyer system, and parking lots. The Bailly Generating Station has a 300-ft greenbelt on its east border that serves as a buffer between Bailly Generating Station generating activities and Indiana Dunes National Lakeshore.

Primary land uses on the east side of the Station are the Indiana Dunes State Park and Indiana Dunes National Lakeshore. The Bethlehem Steel–Burns Harbor complex borders the site to the west and south. The Port of Indiana and Midwest Steel are also to the west. Few residential areas are within 2 miles of Bailly Generating Station due to the Indiana Dunes recreation areas to the east and the preponderance of industrial activities to the south and west. Dune Acres, 2 miles to the east-northeast is the nearest residential community. North of Highway 12, little land is either suitable or used for agriculture. South of Interstate 80 (the Indiana Toll Road), much of the land is used for growing corn and soybeans. About 60% of Porter County land is used for agricultural purposes (Pure Air 1989a).

3.8 RECREATION AND CULTURAL RESOURCES

Much of Porter County's 15 miles of northern border with Lake Michigan is public or private swimming beaches. This a major water sport and recreation area for northwestern Indiana. Indiana Dunes National Lakeshore and Indiana Dunes National Park occupy 13,800 acres of lakeshore, bogs, and marshes. Besides recreation opportunities in these parks, fishing in Lake Michigan is a popular recreation activity (Pure Air 1989a).

The Indiana Dunes has had the active support of many environmental organizations: Save the Dunes Council, Shirley Heinze Environmental Fund, and Friends of Indiana Dunes. The Save the Dunes Council played an important role in the establishment of the national lakeshore and is still active in the area. The Shirley Heinze Environmental Fund works to acquire unprotected duneland for possible addition to the park. Friends of Indiana Dunes is a group committed to preserving and promoting environmental and aesthetic aspects of the Indiana Dunes. The group also promotes scientific research of the ecosystem of the dunes and assists with environmental education programs (Friends of Indiana Dunes 1989).

Deposits of archaeological materials are not known to exist within the Bailly Generating Station boundaries. Three Registered Natural Landmarks are located within a few miles of the site. These include Cowles Bog, immediately to the east; Dunes Nature Preserve, which is within the Indiana Dunes State Park; and Pinhook Bog, situated 12 miles east of Bailly Generating Station. The Joseph Bailly Homestead, located within 2 miles of Bailly Generating Station, is listed in the National Register of Historic Places (Pure Air 1989a).

4. ENVIRONMENTAL EFFECTS

4.1 AIR QUALITY

4.1.1 Construction

Air quality impacts from construction of the proposed AFGD Demonstration Project and associated facilities would occur over approximately 4 months (Pure Air 1989b). Exhaust emissions from heavy construction vehicles, diesel generators, and other construction equipment would be temporary and localized. Vehicular emissions would include small amounts of CO, hydrocarbons, NO_x, and particulate matter.

During site clearing and excavation, particulate matter (i.e., fugitive dust) would be released into the atmosphere. Fugitive dust consists predominantly of large particles that settle quickly and pose minimal adverse public health effects. Effective July 31, 1987, the EPA replaced the existing NAAQS for TSP matter with PM_{10} standards. Because construction would occur on the existing Bailly Generating Station yard, much less site clearing would be necessary than for an undisturbed site. Thus, levels of fugitive dust should be relatively low.

In analyzing fugitive dust emissions from construction, the conservative assumption was made that earthwork would occur simultaneously throughout the 4-acre maximum area anticipated to be disturbed (Pure Air 1989a). An average TSP emission factor of 1.2 tons/(acre•month) for construction (EPA 1985) was multiplied by a conservative 0.3 (actual emissions are expected to be less), the approximate fraction of TSP emissions that are PM_{10} emissions (EPA 1988), to yield a PM_{10} emission factor of 0.36 ton/(acre•month). The product of this factor and 4 acres results in an estimate of 1.4 tons PM_{10} of emissions per month. During construction, sprinkler trucks would spray the roads and construction areas to minimize fugitive dust, reducing emissions by approximately 50% (EPA 1985).

The effect of these emissions on ambient PM_{10} concentrations at or beyond the Bailly Generating Station property perimeter was estimated using the EPA guideline Industrial Source Complex Short-Term (ISCST) atmospheric dispersion model (EPA 1987) and hourly meteorological data from the Dune Acres weather station (1.4 miles southeast). Maximum modeled PM_{10} concentrations generated by construction were added to existing background concentrations to compare the total PM_{10} concentrations with the PM_{10} NAAQS.

The estimated 0.7 ton/month of fugitive emissions was assigned to a 4-acre area source. Because the model requires a square source, a 4-acre square was centered on the general construction area, as shown in Figure 10. A receptor grid of locations at which to estimate concentrations was laid out at 100-m spacing adjacent to the northernmost boundary of the facility because it is the boundary closest to the construction site. Because fugitive emissions modeled as a ground-level area source exhibit maximum concentrations very close to the source, this receptor grid will indicate maximum ambient concentrations anticipated offsite. Annual concentrations projected by the model were multiplied by one-third to adjust for the fact that construction duration will be 4 months.

Table 9 summarizes the results of this analysis and provides a comparison of total PM_{10} concentrations for short-term (24-h) and long-term (annual) averaging periods with corresponding NAAQS. This analysis indicates that no violation of NAAQS for particulate

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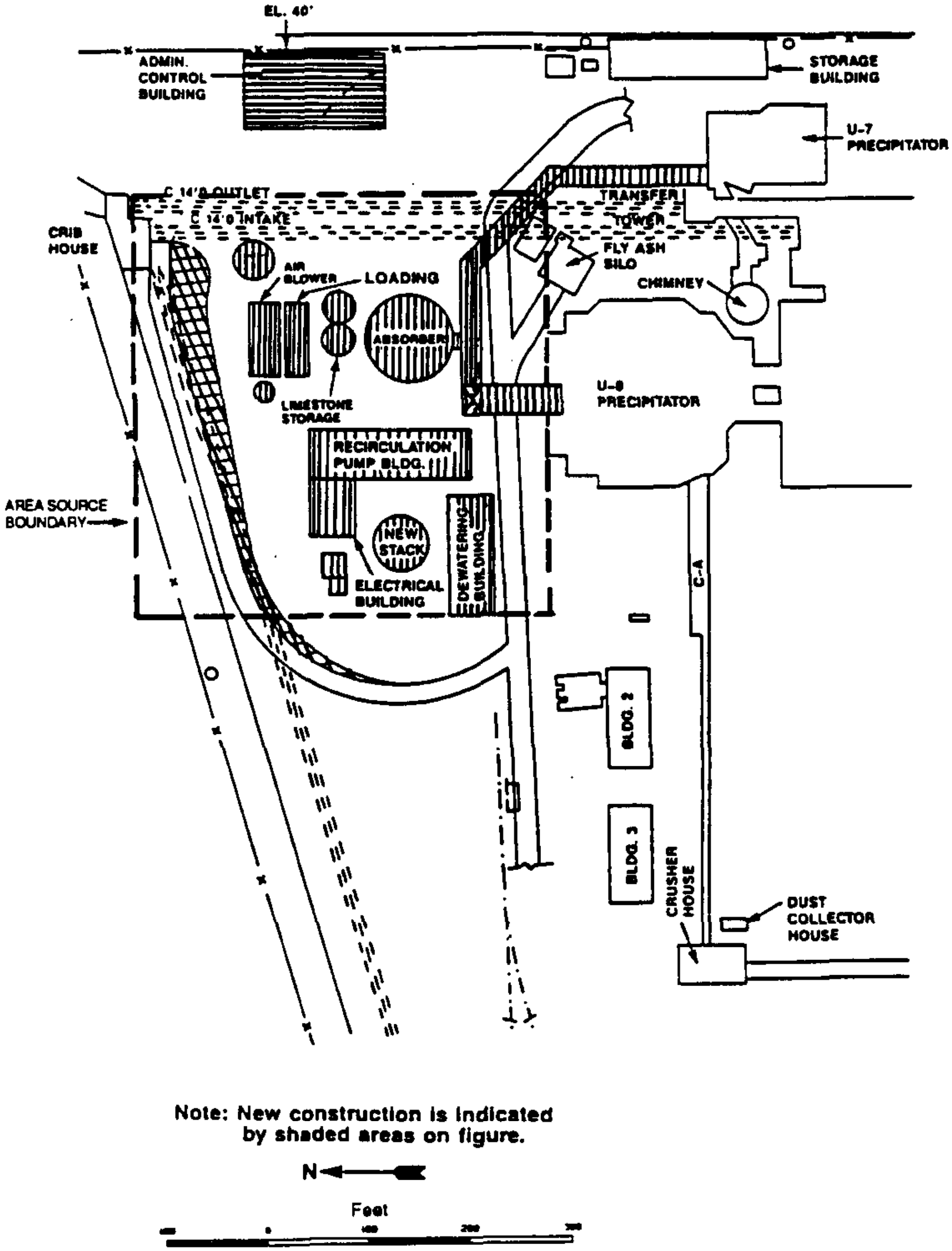

Figure 10. Plot plan of the area used as the fugitive dust source for particulate modeling.

matter is expected. These estimates are expected to be upper limits on expected effects because temporary access roads and laydown facilities will be treated to minimize fugitive dust emissions; no open burning will be allowed, and cleared areas will be covered with hay to minimize potential wind erosion (Pure Air 1989a).

Table 9. Predicted ambient PM_{10} concentrations fromconstruction activities for the advanced flue gas desulfurization demonstration project at Bailly Generating Station

	Predicted PM_{10} concentrations ($\mu g/m^3$)					
Averaging period	Modeled maximum	+	Background[a]	=	Total	NAAQS
24-h	55		73[b]		128	150[c]
Annual	2		32		34	50

[a]*Source:* Ritter, K., Sept. 13, 1989, Indiana Department of Environmental Management, Indianapolis, Ind., monitoring data report sent to M. Mitckes, EBASCO Services Inc., Oak Ridge, Tenn.

[b]Second highest concentration.

[c]Not to be exceeded more than once per year.

4.1.2 Operation

4.1.2.1 Emissions

The principal air pollutants expected from the Bailly Generating Station with the proposed AFGD system are SO_2, NO_x, and particulate matter. The AFGD system is expected to reduce the SO_2 emission rate to between 0.52 and 1.2 lb/million Btu (proposed permit limit). This would be 77 to 90% reduction in annual SO_2 emissions provided the average sulfur content of the coal used is equivalent to that now in use. The process will not change the current NO_x, particulate matter or other pollutant stack emission rates. However, the AFGD system will decrease the net efficiency and thereby increase coal consumption by about 2% to produce the same amount of electricity. Consequently, emissions of NO_x and particulate matter could increase by as much as 2%. The wet limestone slurry will not react with the NO_x; thus, NO_x will not be removed in the SO_2 absorber.

Approximately 50% of the particulate matter in flue gas exiting the ESP will be removed by the AFGD system. However, the AFGD system is expected to add a quantity of particulate matter approximately equal to the amount it removes. Therefore, no net change in rate of particulate matter emissions as measured before and after installation of the AFGD system is expected (Pure Air 1989a). The trace amounts of volatile organic hydrocarbons, fluoride, mercury, lead, or beryllium released during coal combustion may be reduced by the AFGD system, but the extent of the reduction cannot be quantified (M. T. Maassel, Manager, Environmental Programs, Northern Indiana Public Service Company letter to Lance McCold, ORNL, September 15, 1989).

Table 10 presents the emission rates and physical characteristics of the proposed AFGD system stack and the existing stack serving the ESPs at the Bailly Generating Station. The height of the proposed stack is 480 ft, which is nearly the Good Engineering Practice height of 483 ft. Both the stack gas temperature and exit velocity of the proposed AFGD stack are lower than those of the existing stack. The lower gas temperature and exit velocity produce a plume that rises less than the plume from the current stack. As discussed in the next section, reduced plume rise leads to higher ground-level pollutant concentrations

Table 10. Characteristics of the proposed and existing stacks[a]

Parameter	Proposed stack	Existing stack
Height	480 ft	400 ft
Diameter	20.2 ft	15.25 ft
Gas temperature	132°F	295°F
Exit velocity	90 ft/s	212.6 ft/s
SO_2 emission rate	758 g/s[b]	3284 g/s[c]
NO_x emission rate	1074 g/s[d]	1074 g/s[d]
PM_{10} emission rate	63.2 g/s[e]	63.2 g/s[e]

[a]Stack parameters and emission rates are based on Units 7 and 8 at full load.

[b]Based on 1.2 lb of SO_2 per million Btu.

[c]Based on 5.2 lb of SO_2 per million Btu.

[d]Based on 1.7 lb of NO_x per million Btu.

[e]Based on 0.1 lb of PM_{10} per million Btu.

Source: Enviroplan 1989 and Pure Air 1989b.

4.1.2.2 Ambient air quality effects

Air dispersion modeling was conducted using the EPA-approved Industrial Source Complex Short Term (ISCST) model with meteorological data collected in 1986 at Dune Acres (1.4 miles southeast). Emissions rates for the existing stack were based on the actual rates for sulfur dioxide and particulate matter of 5.2 lb/million Btu and 0.1 lb/million Btu, respectively, and a conservatively estimated rate of 1.7 lb/million Btu for NO_x. For the proposed source with a new stack, the emission rates were assumed to be the 1.2-lb/million Btu SO_2 (a 77% reduction from the current rate) specified in the Construction Permit Application (Pure Air 1989b) and were unchanged for particulate matter and nitrogen oxides (i.e., 0.1 and 1.7 lb/million Btu, respectively). The 1.2 lb/million Btu rate for SO_2 is the upper limit of anticipated emissions because the AFGD system is expected to achieve a 90% reduction in emissions to 0.52 lb/million Btu.

Table 11 gives an indication of the expected change in ambient air quality by presenting a comparison of model results for the existing and proposed emission rates and stack conditions. The ambient concentrations of particulate matter and NO_x are predicted to increase slightly, although the emission rates are unchanged. The model results indicate reduced ambient levels of SO_2 for the proposed AFGD system. Maximum 24-h-average concentrations of PM_{10} and annual average concentrations of NO_x increase because of the lower temperature and velocity of the proposed stack's plume.

Table 11. ISCST modeling results for proposed and existing stacks at Bailly Generating Station

Pollutant averaging time	Existing source and stack[a] ($\mu g/m^3$)	Proposed source with new stack ($\mu g/m^3$)
SO_2		
3-h	934	466
24-h	215	128
Annual	9	5
PM_{10}[b]		
24-h	4	11
Annual	<0.5	<0.5
NO_x		
Annual	3	7

[a]Maximum values obtained in modeling.
[b]Conservative assumption was made that all particulate matter is PM_{10}.

While the predicted concentrations of SO_2 might be expected to be much lower for the AFGD case, the exit conditions of the proposed stack partially offset the effect of the lower SO_2 concentration. A plume expands as it moves away from its source. As the plume expands, the concentrations of pollutants in the plume decline. Tall stacks and buoyant exit conditions allow the pollutants in a plume to be diluted before the plume contacts the ground. Decreased plume rise resulting from the reduced exit temperature and velocity of the proposed stack allows less dilution of the plume before contacting the ground. This partially offsets the reduced SO_2 concentrations at the stack exit.

Table 12 is a comparison of NAAQS with predicted concentrations from the AFGD stack added to existing background levels. Existing background concentrations include the contributions from the existing stack emissions, so the total clearly is an overestimate of resulting ambient pollutant concentrations. Table 12 shows that predicted ambient concentrations are safely below NAAQS even with conservative emission rate estimates and without subtracting the contributions of the existing stack to the background concentrations.

Shoreline effects

An additional consideration for any stack source located near a large body of water is shoreline fumigation (Figure 11). Plume fumigation results when a plume emitted from a tall stack and traveling with relatively little dispersion enters the thermal internal boundary layer at some distance inland. As long as this situation exists, fumigation may occur continuously, resulting in higher ground-level concentrations (Touma 1989).

Because the Bailly Generating Station is only about 600 ft from Lake Michigan, the EPA's SCREEN 1.1 computer model (EPA 1988) was used to evaluate the potential effects of shoreline fumigation. SCREEN 1.1 is a model used to evaluate effects quickly but conservatively and requires very little data to give an upper bound estimate of concentration.

Table 12. Sum of background levels and ISCST modeling results for proposed stacks compared with National Ambirent Air Quality Standards

Averaging period	Modeled maximum	+	Background[a]	=	Total	NAAQS
	Predicted concentrations ($\mu g/m^3$)					
SO_2						
3-h	466		430[b]		896	1300[c]
24-h	128		182[b]		310	365[c]
Annual	5		26		31	80
PM_{10}						
24-h	11		73[b]		84	150[c]
Annual	<0.5		32		32	50
NO_x						
Annual	7		46		53	100

[a]*Source:* Ritter, K., Sept. 13, 1989, Indiana Department of Environmental Management, Indianapolis, Ind., monitoring data report sent to M. Mitckes, EBASCO Services Inc., Oak Ridge, Tenn.

[b]Second highest concentration.

[c]Not to be exceeded more than once per year.

SCREEN 1.1 indicated higher short-term (3-h or less) ambient SO_2 concentrations than estimated with ISCST for both current and proposed Bailly Generating Station stack emissions. As with ISCST modeling results, the proposed AFGD system emissions yield lower short-term SO_2 concentrations than current stack emissions. SCREEN 1.1 is believed to overpredict the maximum 3-h SO_2 concentration because monitoring data collected at locations that should be affected by fumigation show maximum short-term concentrations that are very consistent with ISCST results but much lower than those predicted by SCREEN 1.1.

Air quality monitors at Dune Acres Substation (1.4 miles southeast of the current stack), Babcock Road (2.2 miles southeast), and Chesterton Substation (3.8 miles southeast) are at distances and directions where they should be affected by shoreline fumigation. However, the maximum 3-h SO_2 concentration measured at these monitoring stations is consistent with ISCST model results and much lower than the predictions of SCREEN 1.1. The highest 3-h average concentration measured at any of the three sites in 1988 was 776 $\mu g/m^3$ at Chesterton. The maximum 3-h ISCST estimate for the current stack (934 $\mu g/m^3$) is already higher than the measured concentration. Consequently, ISCST is believed to describe conservatively the ambient air quality effects of the current and proposed stack emissions.

Plume visibility

The AFGD plume will have an increased moisture content and lower exit temperature, which will increase the visibility of the plume during certain meteorological conditions. However, the plume still will meet the 40% opacity limit that is expected to be imposed by the IDEM. This is the same permit condition under which the Bailly Generating Station currently operates (Pure Air 1989a). Plumes of high moisture content will totally dissipate from view with distance from the stack.

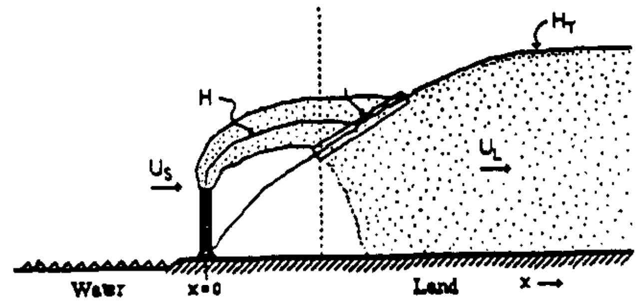

Figure 11. Schematic illustration of shoreline fumigation. *Source:* Touma, J. S. "Development of a Shoreline Dispersion Model." presented at Air & Water Management Assoc. Annual Meeting, June 25-30, 1989.

Emergency generator

In addition to the main AFGD stack, new emission sources will be associated with the on-site emergency diesel generator and with fugitive dust emissions due to bulk material transfer. A 500-hp emergency diesel generator will be installed to provide short-term power needs for quench water to the AFGD system when plant power outages occur. The longest time period that the diesel generator might operate in an emergency situation would be 30 min. Because few emergencies are anticipated, the generator is expected to operate for about 10 min, 1 day per week to ensure that the emergency generator operates when needed. On an annual basis, the generator is expected to operate for less than 24 h.

Fugitive emissions

Particulate emissions generated from material handling will emanate from three sources: reagent (limestone and lime) feed systems, conveyance and transfer of gypsum, and vehicle resuspension. Bulk loading of pulverized limestone or by-product gypsum will be done with enclosed transfer systems to minimize fugitive emissions from these activities. Trucks transporting hydrated lime or by-product gypsum will be covered also, to further minimize on-site emissions to the atmosphere.

Finally, vehicles will enter the site from U.S. Route 12 and proceed on an asphalt-covered road. The total round trip is estimated at 3.2 miles and will result in resuspension of small quantities of road dust (Pure Air 1989b). Annual fugitive particulate emissions for the Bailly Generating Station are expected to decrease because of the implementation of site roadway cleaning. No control methods for fugitive roadway emissions are employed at the facility currently. Net emissions calculated from vehicular traffic associated with the proposed AFGD system plus reduced current fugitive roadway emissions, once controls are implemented, are expected to yield a plant-wide net reduction in fugitive missions (Pure Air 1989b) and a net positive impact to ambient air quality.

4.1.2.3 Acidic deposition

Coal combustion generates atmospheric emissions of SO_2 and NO_x that are suspected of contributing to the formation and deposition of acidic compounds. The effect of atmospheric emissions of SO_2 and NO_x on acidic deposition (acid precipitation and dry deposition) is difficult to quantify. The complex chemical reactions that transform SO_2 and NO_x into acidic compounds that contribute to acid rain are not fully understood, and the source-receptor relationships between power plant emissions and acidic deposition have not been fully quantified (DOE 1989). Acid rain occurs in the eastern United States, with the greatest acidity found in an area from eastern Ohio through Pennsylvania into western and northern New York.

The proposed AFGD system would greatly decrease SO_2 emissions from the Bailly Generating Station. On a regional level, the proposed reduction in SO_2 emissions would be about 0.5% of the 9.4 million tons of SO_2 emissions for the northeast quadrant in 1985 (DOE 1989). Because SO_2 is one of the precursors of acidic deposition, a reduction in SO_2 would reduce the region's contribution to this deposition.

4.1.2.4 Global climate change

A worldwide environmental issue is the possibility of substantial changes in the global climate as a consequence of increasing atmospheric concentrations of "greenhouse" gases, especially carbon dioxide (CO_2). It is generally agreed that fossil fuel burning is the primary contributor to increasing concentrations of CO_2 (DOE 1989).

With the proposed AFGD system, Bailly Generating Station is expected to emit about 5% more CO_2 than do current operations. With only about 8% of global fossil-fuel-related CO_2 emissions linked to coal burning in the United States, a single AFGD system would have negligible effects on global CO_2 concentrations. In fact, commercialization of clean coal technologies as a whole are expected to have only a limited effect on global CO_2 concentrations (DOE 1989).

4.2 SURFACE WATER

4.2.1 Construction

Impacts of project construction on water quality are expected to be minor. Water for construction uses would be withdrawn from Lake Michigan, but the amount would be too small to affect water quality or other uses of the lake. Because of the high permeability of the site's soil (Sect. 3.2), runoff or any materials accidentally spilled from the site would be expected to percolate into the soil instead of directly entering the lake. Stormwater monitoring is not necessary or feasible because surface water runoff is not expected. The AFGD system's construction plans include construction of a stormwater retention ditch on the north end of the site to intercept surface water before it reaches Lake Michigan. Groundwater beneath the proposed construction site moves toward and into Lake Michigan; thus, spilled materials that were not recovered would slowly seep into the lake. Standard industrial practice would be used to control runoff and to prevent or contain spills. Bailly Generating Station's spill response plan would be activated in the event of a spill. Small amounts of dust and litter may be blown into the lake. No impacts to other water bodies can reasonably be expected during construction, except as a result of unusual events such as transportation accidents. Runoff monitoring is not expected to be required.

4.2.2 Demonstration

Demonstration and operation of the project would require continuous withdrawal of up to about 1500 gal/min of AFGD process water from Lake Michigan. Intermittent withdrawals of water up to about 6000 gal/min also would be expected. During normal operations, when the WES is not operating, the 1500 gal/min of process water is discharged to Lake Michigan through the ash pond system and cooling water outfall. When the WES is in operation, about 900 gal/min of the process water will be evaporated in the flue gas duct and released as vapor from the stack. This water consumption is negligible compared with other withdrawals from the lake, such as the 1.4×10^6 gal/min withdrawal at Chicago and the 1×10^8 gal/min average outflow from the Great Lakes.

At Bailly Generating Station's typical cooling water flow (about 150,000 gal/min), the AFGD system wastewater will increase the wastewater discharge by about 1%. Table 4 (Sect. 2) lists the characteristics of the wastewater that would be generated by the AFGD system. This wastewater would be treated in the AFGD system's wastewater treatment facility (Sect. 2.1.3.1) and enter the plant's system of ponds for treatment, mixing with other plant wastewaters, and eventual discharge to Lake Michigan through the cooling water discharge flume (Sect. 3.2). Except for the chloride concentration, the chemical composition of the combined plant and AFGD system wastewater discharged to the lake will be only slightly different from the current wastewater. The AFGD wastewater would increase the chloride concentration in the total discharge from about 10 mg/L to 30 mg/L, which is within the expected discharge permit limits and well below water quality criteria for chloride. These concentrations of dissolved solids would have no deleterious effects on lake water quality.

Some of the gypsum present in the process wastewater as suspended solids can be expected to dissolve into additional calcium and sulfate during the wastewater treatment process. The amount of gypsum that dissolves would depend on the amount of gypsum suspended in the wastewater, the detention time in the wastewater treatment and storage system (which depends on the amount of wastewater being generated and how the ponds are operated), water temperatures, and other factors such as the rate at which gypsum particles settle.

Much of the suspended solid matter generated by the AFGD process should be removed in the settling ponds or, if required, in additional solids-removing treatment processes instead of being discharged to Lake Michigan. Pure Air anticipates a requirement to discharge water with an average suspended solids concentration of less than 30 mg/L and a maximum of less than 100 mg/L. The AFGD system's wastewater treatment system and Bailly Generating Stations existing treatment ponds will be capable of meeting such a requirement. Expected changes to the NPDES permit are described in Sect. 5.2.

The dissolved and suspended materials discharged from the cooling water outfall are expected to be mixed and diluted with lake water rapidly. Mixing at the outfall is enhanced by the velocity with which the water is discharged and by the currents along the shore. Demonstration and operation of the project would generate small amounts of additional sanitary wastewater, which would have only minor effects on the plant's wastewater treatment discharge.

The relationship between acid deposition from coal-fired power plants, flue gas desulfurization, and regional water quality changes is discussed by DOE (1989). Demonstration of the proposed AFGD technology would have the important benefit of determining whether this technology is feasible for widespread use. If the proposed technology works well, it could provide an alternative for the many large coal-fired power plants that need to reduce their SO_2 emissions to control acid deposition, which often affects water bodies. The availability of reliable, effective, and economical technologies for removal of sulfur oxides is one limit on the control of acid deposition; consequently, demonstration of such a technology could be an important positive environmental effect of the project.

4.2.3 Commercial Operation

Long-term commercial operation of the proposed AFGD would have the local effects on water quality discussed in Sect. 4.2.2. Long-term operation of the AFGD plant would have the environmental benefit of incrementally decreasing the emission of sulfur oxides and the resulting acid deposition. Although the reduction in SO_2 emissions at one power plant could not result in major reductions in regional acid deposition and of surface water acidification, it would be a step in the direction of reduced impacts on regional water quality.

4.3 GEOHYDROLOGY

Under normal operating conditions, wastewater will be treated by the AFGD system's wastewater treatment system and discharged into the on-site lined settling ponds (Sect. 3.3.2) (Pure Air 1989a). This wastewater stream is expected to have a high chloride content (about 23,000 mg/L), largely in the form of calcium chloride ($CaCl_2$). The settling ponds are designed to operate so that the wastewater would be retained in the ponds before treatment and discharge into Lake Michigan.

The ponds are lined with clay and synthetic polymer membrane liners designed to prevent pond leakage. Surrounding the ponds, there is a monitoring-well network that was installed because the ponds leaked before they were lined (Sect. 3.3). In December 1983, after monitoring showed that the lined ponds were not leaking, IDEM allowed Northern Indiana Public Service Company to stop monitoring the network of wells. No effects on groundwater are expected as a result of this project and no groundwater monitoring is required or proposed.

4.4 ECOLOGY

4.4.1 Terrestrial Ecology

The area of the proposed AGFD project to be permanently occupied by new construction contains very little vegetation and, thus, minimal animal habitat. Areas to be temporarily used for ancillary activities are within the boundaries of the existing generating station and are currently disturbed. An erosion and sedimentation control plan including use of Best Management Practices should be adequate to prevent impacts during construction. Therefore, construction impacts on terrestrial plants and animals would be minimal.

Operation of the AFGD system should have minimal effects on the regional ecology. SO_2 emissions will be reduced, and annual emissions of NO_x and particulates could increase by about 2% (Sect. 4.1). The projected ground-level concentrations of these pollutants (Table 12) will be below the NAAQS secondary levels, which are set by EPA at levels to protect the environment (ENSR 1988). The reduction in emissions of SO_2 should contribute to reduced acidic deposition in the region. Thus, the impact of the proposed project on surrounding ecosystems should be positive.

4.4.2 Aquatic Ecology

No impacts to aquatic ecology are expected from construction of the proposed project, because the expected impacts to water quality are minimal (Sect. 4.2.1). Demonstration and long-term operation of the proposed project also are expected to have no appreciable impacts to the local aquatic ecology, because the expected changes in water quality and the amounts of water withdrawn from Lake Michigan and discharged from the plant are minor. Some additional suspended solid matter would be discharged. However, the effects of suspended sediment discharges are expected to be minor because lake currents continually move sediments along the lake shore and because none of the suspended or dissolved constituents that the AFGD process would produce are toxic except in concentrations much higher than would be released by the plant.

Widespread implementation of sulfur-removing technologies could eventually lead to reductions in acid deposition in the northeastern United States and in Canada; such a reduction would be beneficial for aquatic environments. The relationship between changes in sulfur emissions from coal-fired power plants and aquatic ecology are discussed by DOE (DOE 1989).

4.4.3 Threatened and Endangered Species

Consultation with the U.S. Fish and Wildlife Service (USFWS) in accord with Section 7 of the Endangered Species Act is complete and indicates that there are not likely to be any impacts of the proposed project on threatened and endangered species or critical habitat.

4.5 FLOODPLAINS AND WETLANDS

Construction and operation of the proposed project would not affect floodplain uses and values. The 100-year flood elevation for Lake Michigan is about 40 ft lower than the proposed construction site, so construction would not occur in the floodplain. The proposed retaining wall (Sect. 2.1.3.2) would be built to a lower elevation than the plant itself, but the construction of the wall is not expected to affect elevations lower than the 100-year flood level.

Construction of the AFGD system will not occur on any existing wetlands nor will any wetlands be affected by construction activities.

There was a dramatic rise in deposition of airborne metal particulates in Cowles Bog from presettlement times to the late 1960s. Deposition has decreased since 1978, probably as a result of emission controls and reduced manufacturing activity in the area (Cole et al. 1989). It is not possible to determine how much of this metal load came from any one industry in the area. However, a change in the composition of the particulate matter being emitted by the Bailly Generating Station should reduce the input of heavy metals to local wetlands (F. T. Bolinsky, Senior Project Manager, Pure Air, letter to Thomas Sarkus, DOE, Pittsburgh Energy Technology Center, Pittsburgh, July 31, 1989). In addition, a reduction in SO_2 emissions (Sect. 4.1) should reduce impacts on wetlands and prevent stresses associated with a lowered pH that can cause changes in wetland species and communities (McLaughlin 1985). Thus, the operation of this project should have a small positive impact on wetlands in the area.

4.6 SOCIOECONOMICS

4.6.1 Population and Economy

The construction of the AFGD system is projected to begin in April 1990 with 100 workers. The manpower requirement is expected to peak in September 1991 at about 400 (M. T. Maassel, Manager, Environmental Programs, Northern Indiana Public Service Company, letter to Lance McCold, ORNL, Oak Ridge, Tenn., September 15, 1989). The average construction work force would be less than 200 workers, which represents a very small project relative to the labor force in the metropolitan area. The construction period would be for about 27 months. A sufficient number of construction workers are located within driving distance of the site so that few, if any, would relocate from outside the area to nearby communities for this period. Therefore, no effects on local population are likely during construction.

The payroll during construction would increase regional income and would result in corresponding increases in secondary income. During the peak 12-month period of construction, the total payroll would be less than $20 million. The effects of increased expenditures would be spread across the regional economy, and no noticeable effects are likely in any specific communities. Because the regional economy is so large, it is unlikely that a project of this size would have any noticeable effect on unemployment.

The workforce for the AFGD system during operation would be 25 to 30. Most of these workers would already be living within the surrounding labor market. Eventually, some may want to relocate to one of the surrounding communities to be closer to their work. There should be no noticeable effect on population or economic activity.

4.6.2 Public Infrastructure

Demands for local services such as schools, fire protection, and police protection are related to changes in local populations. Because no appreciable changes in population are expected, there would not be any important effects on these public services.

It has been estimated that the increased value of property resulting from the AFGD system would increase local tax revenues by $107,000 to $134,000 annually (Rick Klingensmith, Financial Analyst, Pure Air, personal communication with J. W. Van Dyke, ORNL, Oak Ridge, Tenn., Sept. 25, 1989). Of this amount, about 73% would go to the Duneland School District (John Argoudelis, Manager of Taxes and Insurance, Northern Indiana Public Service Company personal communication with J. W. Van Dyke, ORNL, Oak Ridge, Tenn., Sept. 25, 1989). The remainder would go for various other local funds. An estimated $500,000 in sales tax revenues would be collected by the state of Indiana for various expenditures during construction (Rick Klingensmith, Financial Analyst, Pure Air, personal communication with J. W. Van Dyke, ORNL, Oak Ridge, Tenn., Sept. 25, 1989).

The contractor would supply the construction work force with temporary sewage and water facilities (M. T. Maassel, Manager, Environmental Programs, Northern Indiana Public Service Company, letter to Lance McCold, ORNL, Oak Ridge, Tenn., Sept. 15, 1989). Therefore, no additional demands would be placed on the existing systems at the Bailly Generating Station. Some additional solid waste would be generated during construction activities. Along with the additional sewage, this waste would have to be trucked off-site to appropriate disposal sites. Relatively small quantities of waste would be involved.

During the construction period, the flow of traffic to and from Bailly Generating Station will increase. Rush-hour traffic using the access road to Bailly could double during the peak months of construction. If construction workers work the same shift as operating employees, congestion at morning and afternoon rush hours would substantially increase. This effect could be mitigated by staggering the working hours of construction and operating employee hours. Truck traffic also would increase substantially, with approximately 38 trucks (20 tons per truck) to deliver limestone, 1 truck per day for hydrated lime, and 35 to 40 truck trips daily to haul away gypsum (Pure Air 1989a). This increase in truck traffic, spread over the 8-h day, would be about one additional truck every 6 min. The truck traffic would not contribute to rush-hour congestion (M. T. Maassel, Manager, Environmental Programs, Northern Indiana Public Service Company letter to Lance McCold, ORNL, Oak Ridge, Tenn., Sept. 15, 1989). The main effects of the increased traffic would be felt by the Bailly Generating Station employees and construction workers on the Bailly Generating Station access road. Traffic effects would be negligible on public roads and highways in the area.

4.6.3 Noise

4.6.3.1 Construction

Construction activities could generate peak on-site noise levels up to about 110 dBA. This would increase the noise level for brief periods to that of a noisy urban residential area at the nearest residence. The average noise levels during construction are not expected to be objectionable to those living in the vicinity of the nearest residential area. At the nearest point within the Indiana Dunes National Lakeshore, the noise level could be in the range of 55 to 60 dBA, which is about the same as noise levels measured in that area. The effect of this noise on persons in the national lakeshore would be partially mitigated by the trees and sand dunes that are in the greenbelt between the national lakeshore and Bailly Generating Station. Also, construction noise is intermittent and would occur only for a limited period of time.

4.6.3.2 Demonstration and operation

Noise levels during operation were estimated from the sound power levels of equipment to be used in the AFGD system. The total single point sound power level was calculated to be 113 dBA. This would be equivalent to a sound pressure level of 105 dBA at a distance of 3.3 ft from the equipment. For this source noise level, noise levels at points close to Indiana Dunes National Lakeshore's border with Bailly Generating Station were estimated to increase no more than 1.1 dBA as a result of AFGD system operation (F. T. Bolinsky, Senior Project Manager, letter to Thomas A. Sarkus, DOE, Energy, November 16, 1989). Four hundred feet inside the national lakeshore, the noise level would increase no more than 0.1 dBA due to AFGD system operation. To minimize any potential for noise impact to this area, Pure Air will implement a sound survey to verify actual operational noise levels and, if necessary, will perform mitigation to reduce noise levels.

Increased noise might affect visitors to the western portion of the Indiana Dunes National Lakeshore. However, the portion of the national lakeshore in the vicinity of Bailly Generating Station gets relatively little visitor use. The nearest maintained trail comes within approximately 3/4 mile of Bailly Generating Station. Also the national lakeshore is already a relatively noisy area because of U.S. highway 12 along its southern border and because of the industrial activities to the west.

Increased truck traffic from hauling of limestone and gypsum during AFGD system operation also could be expected to contribute to noise levels within the western boundary of the Indiana Dunes National Lakeshore. Noise from these sources would be intermittent and approximately within the background noise associated with operation of the AFGD facility.

4.7 LAND USE

Construction of the AFGD system facility would not change land use at Bailly Generating Station. About 6 acres of cleared land on the existing Bailly Generating Station site will be required for construction activities. After construction, the AFGD system will occupy about 4 acres. On-site land uses for the AFGD system include equipment, buildings, roads, and a gypsum storage area.

The only appreciable change in land use depends on whether or not the gypsum produced by the process can be sold (Sect. 4.9). If it cannot be sold, then a maximum of about 3 acres of additional land per year would be required. This land would be at a permitted landfill. Off-site landfill capacity is available within 50 miles of Bailly Generating Station. The land uses adjacent to Bailly Generating Station (including the industrial land uses to the south and west and the recreational land uses to the east) would remain unaffected.

4.8 RECREATION AND CULTURAL RESOURCES

Consultation with the State Historic Preservation Officer has resulted in a determination that the proposed AFGD system would not affect any known historical, architectural, or archaeological sites listed or eligible for inclusion in the National Register of Historic Places (P. R. Ralston, State Historic Preservation Officer, Indiana Department of Natural Resources, Indainapolis, Ind., letter to R. A. Hargis, Jr., DOE–Pittsburg Energy Technology Center, Pittsburg, Penn. Dec. 4, 1989). However, if any archaeological artifacts are discovered during construction, work will be stopped and the discovery will be reported to the Division of Historic and Preservation and Archaeology in the Indiana Department of Natural Resources.

4.9 SOLID WASTE

The AFGD system potentially will alter the production of solid waste at Bailly Generating Station. In the process of reducing SO_2 emissions, the flue gas from Bailly Generating Station will react with limestone. The main by-product of this reaction will be between 500 and 700 tons of gypsum per day. If the gypsum is of high enough quality, it can be sold to wallboard manufacturers. Table 3 (Sect. 2) lists the anticipated composition of the AFGD system's gypsum and wallboard manufacturers' requirements for gypsum. Based on the characteristics reported in Table 3, the AFGD system's gypsum should be salable. However, if for any reason it is not sold, it must be disposed of as solid waste. Properly disposed waste gypsum would not be expected to pose either an environmental or a public health hazard.

The Bailly Generating Station typically produces about 40,000 tons of fly ash per year. At peak loads, a maximum of about 14,000 lb/h of fly ash is generated. The quantity and characteristics of fly ash generated during operation of the AFGD system will be the same as for the current operation of the Bailly Generating Station. However, when the WES is operating, as much as 1200 lb/h of additional solids will be generated (Pure Air 1989a). Testing of the WES is expected to occur over several months (F. T. Bolinsky, Senior Project Manager, Pure Air, letter to Thomas Sarkus, DOE, Pittsburgh Energy Technology Center, Pittsburgh, Penn., August 22, 1989). The WES solids, which would contain about 60% chlorides by weight, are expected to have the following composition:

$CaCl_2$	73.1%
$Ca(OH)_2$	0.4%
$MgCl_2$	15.6%
$CaSO_4 \bullet 2H_2O$	9.4%
CaF_2	0.2%
Fly ash	1.1%
Other	0.2%

Because the WES solids are collected with the existing fly ash, the leachate from the combined fly ash and WES solids could contain about 2,500 mg/L of chlorides. The mixture of fly ash and WES solids will be sold to a broker for resale for other uses as is currently done. Fly ash and products of flue gas desulfurization are exempt from federal control under RCRA. Fly ash is not regulated by the Indiana Office of Solid and Hazardous Waste Management if it is used for beneficial purposes or disposed of in an appropriate landfill (F. T. Bolinsky, Senior Project Manager, Pure Air, letter to Thomas Sarkus, DOE, Pittsburgh Energy Technology Center, Pittsburgh, August 22, 1989). Adequate landfill capacity is available for disposal of any fly ash and WES solids that are not sold.

5. PERMITS AND REGULATORY REQUIREMENTS

5.1 AIR

The Bailly Generating Station operates under permits 64-07-92-0245 (Unit 7), 64-07-92-2046 (Unit 8) for the coal-fired boilers and 64-07-92-0247 for the oil-fired gas turbine (Unit 10) from the IDEM. These permits expire July 1, 1992, and were last renewed by application June 16, 1988.

A construction permit was requested for the proposed AFGD system in August 1989, and issuance is anticipated in the first quarter of 1990. Emission limitations will be placed on the same parameters that are in the existing air permit (SO_2, TSP, and opacity). The application included information on the process, stack parameters, and proposed emission limits for operation of the AFGD system and was supported by modeling using methods approved by the Office of Air Management (Pure Air 1989a).

5.2 WATER

Bailly Generating station's wastewater discharges (including cooling water) are regulated by the IDEM under permit No. IN 0000132. This permit is valid until 1993. The current permit requires sampling and reporting of total suspended solids, oil and grease, total iron, total copper, biochemical oxygen demand, fecal coliform bacteria, and total residual chlorine at various internal monitoring points. There are no permit limits at the main outfall to Lake Michigan.

Northern Indiana Public Service Company and the IDEM are negotiating a permit for Bailly Generating Station with the proposed AFGD system. On August 22, 1989, Northern Indiana Public Service Company submitted information to the Indiana Department of Environmental Management on the changes in wastewater that the proposed AFGD project would entail and requested that the department modify the wastewater discharge permit as necessary to accommodate these changes. Proposed permit limits would include the addition of a new internal monitoring point at the AFGD systems' wastewater treatment facility with limits on total suspended solids, and oil and grease. Proposed permit limits for the main outfall are listed in Table 13. The wastewater treatment system is being designed to meet the expected requirements of a revised permit.

5.3 WETLANDS AND FLOODPLAINS

Because the proposed project will not involve modification to wetlands or floodplains, no permits or notices for dredging or filling of wetlands or floodplains modifications are required.

Table 13. Proposed permit limits for the Bailly Generating Station main wastewater outfall

Parameter	Monthly average (mg/L)	Daily maximum (mg/L)
Total suspended solids	30	100
Oil and grease	15	20
Chloride	30	40
Total dissolved solids	394	400
Sulfate	52	100
Fluoride	1.4	2.0

Source: F. T. Bolinsky, Senior Project Manager, Pure Air, letter to Thomas Sarkus, DOE, Pittsburgh Energy Technology Center, Pittsburgh, Penn., Jan. 23, 1990.

5.4 ECOLOGICAL RESOURCES

Consultation with the USFWS in accordance with Section 7 of the Endangered Species Act is complete and indicates that the project will not affect any threatened or endangered species or any critical habitat.

5.5 CULTURAL RESOURCES

Consultation with the State Historic Preservation Officer has resulted in a determination that the proposed AFGD system would not affect any known historical, architectural, or archaeological sites listed or eligible for inclusion in the National Register of Historic Places (P. R. Ralston, State Historic Preservation Officer, Indiana Department of Natural Resources, Indainapolis, Ind., letter to R. A. Hargis, Jr., DOE–Pittsburg Energy Technology Center, Pittsburg, Penn. Dec. 4, 1989).

5.6 SOLID WASTE

No permits or approvals are required or anticipated for disposal of ash. If disposal of gypsum were required and if it were classified as a flue gas desulfurization sludge, no permit would be required to dispose of it in a sanitary landfill. If the gypsum were classified as a special waste, an analysis of its leachate would be required by the IDEM. With the results of the leachate test, the IDEM would classify the material and specify the types of landfills that could accept the material.

6. FINDINGS

One of the purposes of an EA is to provide sufficient evidence and analysis to determine whether the proposed action could have a significant impact on the human environment. If an EA shows that the proposed action is likely to result in a significant impact, an environmental impact statement must be prepared. If not, a "Finding of No Significant Impact" is issued.

The impacts of the proposed action have been evaluated relative to the nine indicators of significance specified by the CEQ (40 CFR Pt. 1508.27). The results of this evaluation follow.

- **The degree to which the public health or safety would be affected:**

  Public health and safety would not be affected by the project.

- **Unique characteristics of the geographical area:**

  The unique characteristics of the area center upon the location of the site relative to the Indiana Dunes National Lakeshore. No adverse impacts to the Indiana Dunes National Lakeshore are anticipated. AFGD system operation would result in a modest reduction in average SO_2 concentrations at the National Lakeshore.

  There may be some short-duration above-background noise levels in Indiana Dunes National Lakeshore (a unit of the National Park System) resulting from construction. Operation of the AFGD system is expected to result in noise level increases of no more than 1.1 dBA at the national lakeshore. At the national lakeshore's nearest boundary, the noise level with current operations has been found to be between 58 and 61 dBA. The proposed AFGD system is expected to increase the noise level at the national lakeshore's western boundary to between 59.1 and 61.6 dBA. Four hundred feet inside the national lakeshore, the noise level is expected to increase no more than 0.1 dBA due to AFGD system operation. This noise level increase is based on equipment vendor information. To minimize any potential for noise impact to this area, Pure Air will perform a sound-level survey to verify actual operational noise levels and will initiate mitigation if necessary.

- **The degree to which the effects on the environment are likely to be highly controversial:**

  From a broad perspective, the general public supports efforts to reduce emissions of acid rain precursors. From a local perspective, there are environmental groups in the area that are very interested in potential effects to the area in general and to the national lakeshore in particular. Through meetings held by Pure Air and correspondence with DOE, the groups have been kept informed as to the nature and magnitude of the predicted local effects and have not expressed any formal opposition to the project.

- **The degree to which the environmental effects are highly uncertain or involve unique or unknown risks:**

    The technology and effects of the proposed action are not expected to present significant unknown risks.

- **The degree to which the proposed action establishes a precedent regarding future actions with significant effects:**

    No precedent or constraint on future actions are expected to established by the proposed action.

- **Whether the action is related to other actions with individually insignificant but cumulatively significant impacts:**

    There are no current activities in the region that, combined with the expected impacts of the proposed project, would be expected to result in significant cumulative impacts. With regard to criteria pollutants, the proposed AFGD system at the Bailly Generating Station would result in substantially lower emissions of SO_2 and slight increases in particulates and NO_x. The cumulative effects of these emissions with respect to other local and regional emissions are small decreases in regional emissions of SO_2, modest decreases in ambient concentrations of SO_2, and small local increases in ambient concentrations of NO_x and particulates.

- **The degree to which the action may cause loss or destruction of significant scientific, cultural or historic resources:**

    There are no known archaeological, historic, cultural, or scientific resources that will be affected by construction or operation of the AFGD system.

- **The degree to which the action may adversely affect threatened or endangered species or its critical habitat:**

    No federally listed threatened or endangered species are found on the Bailly Generating Station site. The dune thistle is the only federally listed threatened or endangered species regularly occurring at the nearby Indiana Dunes National Lakeshore. Consultation with the USFWS is complete and indicates that construction and operation of the AFGD system would not affect the dune thistle.

- **Whether the action threatens violation of federal, state, or local law, or environmental regulation:**

    Analysis of atmospheric emissions, wastewater discharges, and potential solid wastes indicates that neither construction nor operation of the proposed AFGD system would threaten to violate any federal, state, or local law or regulation imposed for protection of the environment.

7. PREPARERS

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